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The Preservation of Timber.

HAVING regard to the more or less problematical character of the protection afforded by various processes intended for the preservation of timber, the Administration of the State Railways of France decided to make systematic investigation into the whole subject. For this purpose they enlisted the services of Professor H. Devaux, of the Faculté des Sciences de Bordeaux, and M. H. Bouygues, D.Sc., to conduct the necessary experiments. Although the inquiry has not yet been completed, some instructive results have been obtained with regard to the penetration of heat into timber during the process of treatment.

In the present state of knowledge it is an open question whether parasitic growths, feeding upon and destroying the living tree, continue to live in and upon timber after it has been cut and applied to structural work. It is generally recognised that wood, consisting chiefly of cellulose practically indestructible under ordinary conditions, only suffers decomposition in the presence of sap or sap residues containing diastatic ferments and parasites. The absolute sterilisation of all living organisms in timber is consequently a necessary prelude to the injection of merely antiseptic substances, which rarely penetrate for more than a short distance beneath the surface. Moreover, if in timber that has been treated cracks appear which penetrate to interior parts neither sterilised nor impregnated, the door is at once opened to destructive agencies in spite of the preservative treatment upon which reliance has been placed.

In nearly every process for the preservation of timber, heat is applied in one way or another with the object of effecting sterilisation. In some cases the material is submitted to the action of steam, in others to that of hot air, and in others again it is immersed in a hot solution of the antiseptic substance. Admitting that steaming or other means of applying moist heat is useful for softening and distending the fibres so as to facilitate absorption of the antiseptic liquid, we must not lose sight of the fact that sterilisation is a still more desirable object. Consequently the penetration of heat into timber properly constitutes the first object of study in any inquiry into preservative methods.

MM. Devaux and Bouygues commenced their investigations by submitting to the action of heat cylinders of maritime pine, some consisting of sap-wood and others of heart-wood. All the cylinders were $15\frac{3}{4}$ in. long, and of diameters ranging from 1·89 in. to 4·92 in. When the cylinders were placed in saturated steam at 212° F., the temperature of the wood slowly increased, the rate of increase became rapid at from 176° to 194°, and then again became slow, the temperature of 212° being attained only after a considerable lapse of time. For the larger cylinders under examination the temperature of 208° was not reached until the timber had been in the steam for six hours. Between 95° and 131° the temperature curves for all the cylinders approached sensibly the form of a straight line, thus permitting comparison of the time required for the penetration of heat into cylinders of various diameters.

Table I. gives the observed and calculated results obtained by MM. Devaux and Bouygues for cylinders of various diameters between the temperatures of 95° and 131° F. :—

TABLE I.—THE PENETRATION OF HEAT INTO PINE CYLINDERS FROM SATURATED STEAM AT 212° F.

Sap-wood.				Heart-wood.			
Diam. d	Duration of Heat t	Value of $\frac{t}{d}$	Value of $\frac{t}{d^2}$	Diam. d	Duration of Heat t	Value of $\frac{t}{d}$	Value of $\frac{t}{d^2}$
Inches.	Minutes.			Inches.	Minutes.		
1·89	4·3	2·27	1·20	1·89	5·1	2·70	1·43
2·72	6·7	2·46	0·90	2·72	9 0	3·31	1·22
3 35	11·0	3·28	0·98	3·35	14·9	4 45	1·33
4·13	18·4	4·46	1·08	4·13	23·9	5·78	1·40
4·92	26·4	5·37	1·07	4·92	30·4	6·18	1·25

From this table it will be seen that the time required for the penetration of heat into a cylinder may be taken without serious error as being inversely proportional to the square of the diameter. This conclusion is interesting from the theoretical standpoint because it agrees very fairly with the theory of Fourrier on the penetration of heat through homogeneous cylinders, and still more interesting from the practical point of view, because it affords a direct clue to the relative rate of heat penetration into timber cylinders of different diameters. During the process of steaming, water was absorbed by the timber to a considerable extent, especially in the cylinders of sap-wood, the proportionate volume of water increasing with reduction of diameter. This result is obviously due to the same causes as those which govern the penetration of heat. Owing to the low conductivity of air, and the still lower conductivity of woody fibre, the penetration of heat into timber during the process of steaming would be exceedingly protracted were it not for the condensation following the emission of latent heat that takes place as the steam comes into contact with the relatively cold material, and the more rapid conduction of heat through the water of condensation absorbed by the timber. This sequence of operations—condensation, absorption, and conduction—is continually repeated in timber surrounded by saturated steam, and the rapidity of heat penetration is in proportion to the rapidity of condensation and the readiness with which water is absorbed. Moist timber should be more rapidly heated to the centre than dry timber, because water is a better conductor of heat than air. The accuracy of this view is confirmed by the results contained in Table I.

MM. Devaux and Bouygues do not appear to have made any investigation into the effect of apparatus designed to extract occluded air before heating the timber by steam. We certainly think they would do well to extend their researches in this direction, as it is very probable that they would find a marked increase in the rate of penetration through timber after the removal of air by a simple vacuum apparatus, such as that employed in steam disinfection chambers.

In Table II. we give some figures relative to the weight of water actually absorbed by some of the cylinders tested.

TABLE II.—ABSORPTION OF CONDENSATION WATER BY TIMBER DURING THE STEAMING.

Diam.	Duration of Heating.	Weight of Timber.		Water Absorbed.
		Before Test.	After Test.	
In.	Minutes.	Lb.	Lb.	Lb.
	Sap-wood.			
1·89	40	0·91	1·03	0·12
4·92	203	6·38	6·90	0·52
	Heart-wood.			
1·89	52	0·86	0·884	0·024
4·92	303	6·05	6·292	0·242

Bearing in mind the proportion of water absorbed as the result of treatment by saturated steam, we see that in processes where the injection of antiseptic solutions is preceded by steaming, the increased weight of the treated timber must not be attributed entirely to the absorption of the preservative material.

Similar experiments were conducted by exposing pine cylinders to the action of superheated steam at the temperature of from 266° to 338° F. Notwithstanding the high temperatures thus provided, it was found difficult to heat the timber up to 212° F. at the centre of the specimens tested, even after prolonged exposure.

This result can easily be accounted for by the extremely slow conductivity of superheated steam, which does not begin to act as a really efficient heating medium until it has been more or less slowly reduced to the state of saturated steam by the transfer of heat to the colder objects with which it may be in contact. After reduction in this way heat is more rapidly conducted through the water of condensation. It would have been interesting if the investigators had made tests with saturated steam at temperatures equal to those of the superheated steam, for the purpose of comparison.

A third series of tests with air at the temperature of 284° F. indicated a far slower rate of penetration than that obtained by the employment of steam, thus demonstrating the well-known inefficiency of hot air for heating substances in the manner here considered.

MM. Devaux and Bouygues subsequently made tests upon pine railway sleepers, some green, some dry, others consisting chiefly of sap-wood, and others again chiefly representing heart-wood. For six specimens submitted to the action of saturated steam at 230° F. for sixty minutes, the temperatures in the middle of the wood were 80·6°, 91·4°, 93·2°, 101·3°, 102·2°, and 113° F. These variations are very marked, but it was found after prolonging the steaming process for ninety minutes that the maximum interior temperature in no case exceeded 111·2° F., while after steaming for sixty minutes the temperature never reached 122° F., at the depth of from 4 centimetres to 5 centimetres below the surface. In every case, whether the sleepers were green or dry and whether they consisted chiefly of sap-wood or of heart-wood, there was always an increase of weight owing to the absorption of condensation water, the amount of water absorbed varying from about 0·5 lb. to 1 lb. for sleepers weighing from about 110 lb. to 154 lb. each.

The investigators also observed the increase of temperature in pine sleepers during treatment by the process adopted in the State Railway Works at Saint-Mariens. The sleepers were placed for a period of from thirty to fifty minutes in saturated steam at 230° F.; pressure was next relaxed and maintained for forty minutes at the point corresponding with a partial vacuum of 2·36 in. of mercury. Then a mixture of creosote and chloride of zinc, heated to 176–194° F. was introduced, and when the chamber was completely filled the pressure was increased to 85·3 lb. per square inch, and so maintained for from twenty to twenty-five minutes. The maximum temperature attained in the middle of the sleepers ranged from 114·8° to 122° F. for timber consisting chiefly of heart-wood, and from 125·6° to 131° F. for timber consisting chiefly of sap-wood. By prolonging the process so that the partial vacuum and the compression each extended to the period of sixty minutes, the temperatures increased to 149° F. for a sleeper chiefly of heart-wood, and to from 149° to 158° for three sleepers chiefly of sap-wood. By the preservative method cited above the temperature attained in the interior of the sleepers was in no case very high, only exceeding 140° F. under quite exceptional conditions that are never realised in ordinary practice, and as a general rule the interior temperature was in the neighbourhood of 122° F.

These facts being satisfactorily established, we are justified in arguing that as absolute sterilisation cannot be assured at temperatures below 240° F., the temperatures reached in the interior of timber during treatment by the process here in question—and by other processes of similar character and with similar temperature limits—cannot possibly ensure the sterilisation of destructive organisms. It may be the fact that the outer portions of the timber are protected by the antiseptic liquid absorbed, but the inner portions to which the antiseptic does not penetrate are not benefited. If spores exist in such parts they cannot be killed by the inadequate temperatures given by low-pressure steam, and their activity is not reduced by the antiseptic substances ordinarily used, owing to the failure of the liquid to penetrate to a sufficient distance beneath the outer surface of the wood.

To ensure absolute sterilisation the timber must be heated throughout—preferably by saturated steam—to the temperature of at least 240° F., and this temperature must be maintained for not less than fifteen minutes, or the timber must be completely saturated with a solution capable of destroying living organisms and spores.

A LITTLE TOUR IN BURGUNDY.

FROM A CORRESPONDENT.

I MAY perhaps be allowed almost to pirate the title of a well-known book and call this article "A Little Tour in Burgundy," because this best expresses its character. One of the chief difficulties alike of busy men and active students is to formulate a little tour to occupy only a few days having an architectural object throughout. One knows of this place and that, but it is not easy to amalgamate several places into one convenient brief expedition. And if a short tour be commenced, and any mistake has been made in the plan, the whole holiday may be spoiled, for time is the essence of the little tour. I premise then that the *voyageur* has architectural instincts, a desire to know France better, to be free from his own countrymen and his own newspapers; and so having reached Paris I transport him at once seventy miles southwards to the historic and—to the stranger—rather dull town of Sens.

At Sens the cathedral dominates and

overwhelms the whole town. The mellow boom of its huge bells seems to signify its mastery of the entire place—everything else is so insignificant in comparison. Yet the new Hôtel de Ville, completed in 1903, is a most interesting modern building, one which, if an amateur may make such a suggestion, is well worth careful study by anyone engaged in the art of architecture. I say nothing about the resemblance of Sens to Canterbury—these and other things have been said many times before; but where among cathedrals is there, as I think, so conspicuous and clear an example of the union between Eastern and Western architecture as in the pillars of the nave? With the square abacus, the floriated ornamentation of the capital, and the swelling roundshaft, they seem transported direct from some Grecian temple. And the eye glances from them to the pointed arches and windows of the choir, purely Gothic in expression and feeling.

From Sens to Troyes is about forty miles by rail, and those who have the time—and the energy—can easily accomplish a visit to this town and its cathedral in a day, returning to Sens to continue the little tour southwards into the heart of Burgundy. At the junction called La Roche the main line is left, and in less than an hour one is at Auxerre. However warm the day may be one should always walk from the station to the town—the half-mile of the road as far as the river is hot, dusty, and shadeless, but in front on the escarpment above the broad and tranquil Yonne is grouped the town and its churches—in the centre the east end of St. Étienne overhangs the river, beneath it is the Romanesque gallery of the old Episcopal Palace; on one hand is the tower of the former Abbey Church of St. Germain, and on the other is the ornate tower of St. Pierre. The houses of the city, picturesquely grouped between these buildings, give a singular completeness to the scene. But the moment the actual city is entered this impressiveness disappears. The streets are narrow, the houses insignificant if often picturesque. The churches, interesting and remarkable, become single buildings, the ornate West XIIIth-century front, the interesting sculpture and details of the exterior would alone make the building worthy of a long visit; but for simple picturesque force, the *tout-ensemble* of Auxerre from a distance is not easily equalled.

It is only some two hours from Auxerre to Avallon, the most agreeable centre in Burgundy, a pleasant and cheerful little town, ordinary enough on the northern side, but striking to the south-east. Here it overlooks, with its ancient Tour de l'Horloge, its remnants of city walls, its Church of St. Lazare with a sculptured western front, the deep valley of the Cousin. Innumerable little garden terraces cover the steep sides of the hill, whilst around and beyond the country is a striking mixture of fertility and wildness, for the hills are in places covered with vineyards, and, where more exposed, with copses and woods. It is from Avallon that Vézélay is reached. The carriage (if you are not a cyclist) which takes you over the nine and a half miles of road will not be very new nor the horse speedy, but this matters not, for as there is much to note you should go at the pace of a pedestrian. You pass along by the lively trout stream, and presently at Pontaubert break from the valley. You stay there to see the small but noteworthy XIIth-century church, well proportioned and massive, with a considerable porch of later date. A little avenue of lime-trees leads from it; at the beginning is an ancient cross, representing on one side the Virgin and Child, on the other the Crucifixion. These crosses, usually about 12 ft. high, are numerous in this country, and one wonders how they have managed to survive through so many centuries. The road ascends and passes over an upland country past a château and a village, then, descending, crosses the Cure, where an interesting single arch mediæval bridge still stands below the modern structure. Presently Vézélay is seen perched high on the hill top, where St. Bernard, in 1145, preached before Louis VII. the holiness of a new crusade. But at the foot of the steep hillside cluster in close contiguity the houses of St. Père de Vézélay. You note the tower of the church soon after you pass the Pont de Cure, but are unprepared for the gemlike church surrounded by the squalid village which, like Vézélay itself, has by reason of the vine disease fallen on bad times. The proximity of Vézélay itself has rather diminished the interest and importance of the Church of St. Père. It is a miniature cathedral, with a triple porch of marvellous richness, a striking narthex, and beyond this the XIIIth-century Gothic building on the same model as Sens and Canterbury. In a sense it is English, because it is complete and small. So much in France, when one comes to mediæval architecture, is incomplete that one feels at St. Père that, though the feeling and character of the building are so essentially French, you have something of the moderation and measure of the English builders. It is soon time to climb the hill to Vézélay; the ridge rises sharply, and from it all the surrounding country is visible. Vézélay is a town of the past, an open-air museum; one would almost suppose it to be uninhabited. A long narrow street of dilapidated and half-empty houses leads up to the Abbey Church.* Like Auxerre, Vézélay loses by proximity the character which distance gives to it, and the long church, 404 ft. externally, is by no means impressive, beautiful as is the western front. But the interior makes up for the exterior. The narthex is very large; round it is a gallery which is connected with the nave, which itself is entered by three inner porches with twisted pillars, whilst above it abounds in sculpture, the most remarkable of all being that in the tympanum over the central doorway, a copy of which one may see in the Trocadéro at Paris. Protected from the weather, the pictured stone is beautiful in its antiquity. The sculptors had full range, and the student of to-day can nowhere study mediæval religious sculpture better preserved or with greater ease. The Church of Vézélay in its size, its massiveness, and something of Eastern feeling, was a fitting place for the beginning of two crusades; it helps to give some reality to words which are difficult of realisation, some indication of the enormous spiritual forces which were at work, of the gigantic energy, of the unconsidered waste of human life, which marked the movements which commenced in the great Abbey Church on the hill top of Vézélay. Perhaps Vézélay, with its traditions and its picturesqueness and its grandeur, should terminate a tour. The Château of Chastellux, amid its woods and water, is a delightful piece of domestic architecture. Four-towered Semur on its heights surrounded by the winding Armancon is most attractive. Dijon, old and new, is full of interest. The town is in itself respectably commonplace and the churches lose somewhat by their situation, but the storied west front of Notre-Dame is charming; that of St. Michel, the ingenious work of Hugues Sambon, of Dijon, one of Michelangelo's pupils, is a kind of puzzle. Not to be overlooked are Autun and Saulieu and Baune, each of which is easily accessible from Avallon or Dijon. But those who can afford indefinitely to wander among the Burgundian towns and churches scarcely want to read of a little tour which, for my purpose, ends at Dijon, and the remembrance of which is unquestionably dominated by Vézélay and by St. Père at the hill foot.

E. S. R.

*Architectural students should obtain a monograph on the Abbey Church, by Hector De George, republished from the "Journal de l'Architecture, 1905," published Paris, Rue des Ecoles 59. The present guardian of the Church, Bobelins, was a sculptor mason who worked for many years on the restoration of the church. In English cathedrals the butler of the Dean or Bishop obtains these appointments; in France they are the reward of a life work of technical labour, and a person with technical knowledge is appointed by the State.

NOTES.

The Institute Special Meeting.

WE think it is better to leave the proceedings at the Special Meeting of the Institute on Tuesday in the conventional privacy in which it was supposed to be held. Considering that the conditions for the London County Council Hall competition have been so long issued, and that probably many of the competitors are well on with their schemes, it was not very wise to call a meeting at this date for an attempt to get them revised—an attempt which was almost bound to be a failure in any case; and some not very wise things were said (on both sides) in the course of the discussion. We may congratulate the Institute that the resolution proposed on behalf of those who objected to the conditions was lost by a considerable majority—its supporters would have been wiser to have acceded to the request of the President to withdraw it; had it been carried and acted on, the result would not have been beneficial to the Institute. Some of the objections made to the position given to the Council's architect in connexion with the competition were shown, in our opinion, to be more imaginary than real. There is only one point on which a change might still be made with advantage, and without prejudicing those who have already got their designs in hand—the appointment of, say, two more professional assessors to form a jury for making the selection from the first competition. Considering

the immense importance of the work, and the probable great number of competitors, it would seem that the selection for architectural promise ought not to depend on one assessor only, however eminent; and this is practically the situation, for we may take it that the province of the Council's architect is mainly to decide on the adaptability of the plans for the practical work of the Council. It is too late now to think of asking the Council to alter the required scale of the drawings, which we thought from the first to be unnecessarily large; and an additional reason was given in regard to this point on Tuesday, in the suggestion that what was wanted in the first competition was some great architectural ideas from great architects, and that we should be more likely to get these in drawings on a smaller scale, in which there might be more of the individual work of the eminent architect and less of the usual draughtsman's working out. This is quite true, and we recommended a reduction of the scale when it would still have been possible to make the alteration; but it is obviously too late now.

Costs and the Tribunal of Appeal. THE case of London County Council *v.* Metropolitan Railway and Others (the *Builder*, p. 612) decided a point of some importance. On an appeal to the Tribunal of Appeal as to the certificate of the Superintending Architect defining the building line, the Council had appeared to support the decision of the architect. The Tribunal had varied the building line as defined by the architect, and had given the parties costs as against the Council. The Council appealed to the Divisional Court on the question of costs, and the Court held that the Tribunal had power to order the Council to pay costs, but gave leave for a further appeal. Sect. 25 of the London Building Act, 1894, which gives the right of appeal to the Tribunal of Appeal, is as follows:—"The local authority or any person deeming himself aggrieved by the certificate of the Superintending Architect may appeal to the Tribunal of Appeal." A reference to the definitions in sect. 5 shows that the words "the local authority" do not denote the County Council, therefore, they are not "parties"; but sect. 181 makes it lawful for the Council to defray the expenses of supporting any decision of the Superintending Architect, and sect. 183 gives the Tribunal power "to hear the Council and the parties interested . . . . and the costs of any parties to the appeal, including the Council, shall be in the discretion of the Tribunal." These sections seem clearly to provide for the point raised in this case, but the decision upon them is of importance to those who, in disputing the architect's certificate, have to encounter the opposition of the Council.

Railway Safety Devices. WE are not at all surprised to find in the *Journal* of the Franklin Institute a paper entitled "Railroad Management and Safety Devices," for the appalling number of serious accidents in the United States has at last convinced all classes of the necessity for drastic reforms on American railways. The author of this paper, Mr. J. C. Irwin, of the New York Central and Hudson River Railroad, shows that while most of these disasters have taken place on lines where the block system is absent or incompletely adopted, many of them have been due to defective equipment and disregard of signals on lines operated on approved modern principles. Mr. Irwin enunciates two maxims that deserve to be written in letters of gold, or, better still, to be written as a task, say, fifty times a week by every railwayman in the United States. One is the motto, "Eternal vigilance is the price of safety," and the other, "In all cases of doubt and uncertainty, the safe course must be taken, and no risks run." However perfect may be the safety devices provided, unnecessarily frequent accidents will still continue in the United States unless railway directors and responsible officials make up their minds to stamp out the reckless and foolhardy methods now tacitly approved in every part of the country. Mr. Irwin's paper is concluded by a detailed description of the signalling system that is being applied to the electrically-operated suburban lines of the New York Central and Hudson River Railroad. This installation deserves attention as an example of the most modern signalling practice in connexion with electric traction.

Engineering Reports on the San Francisco Earthquake. IN the *Proceedings* of the American Society of Civil Engineers there are full reports of the various committees appointed to inquire into the effects of the San Francisco earthquake on engineering constructions. In addition to committees on geology, buildings, waterworks, lighting and street railway transportation, sewers, railway structures, and highway structures, six sub-committees were formed at the suggestion of the municipal authorities. We quite share the opinion experienced by the committee on geology that the disastrous results following the earthquake were largely due to a lack of safe construction, and that the Pacific Coast can be made safe for purposes of habitation if the lessons of the recent disturbance are taken properly to heart. One of the most interesting reports of the series is that by the committee on buildings. Speaking in general terms, the committee state that the primary requisite of buildings is elasticity, such as that insured by timber or steel frames and concrete-steel, and that buildings of stone, brick, or block construction with horizontal mortar joints will not answer requirements at all. Walls of brick or brick faced with stone are characterised as hopelessly inadequate. With regard to damage by fire the same committee specially emphasise the point that all structural materials were destroyed when directly exposed to fire for any length of time. A deduction drawn by the committee from this fact is that all structural parts of a building should be protected by another material, which will be more or less completely destroyed in case of fire. However good this advice may be in the case of steelwork, we think a more practical recommendation would be that all buildings should be of the most approved fire-resisting construction, thus obviating the risk of anything more serious than purely local outbreaks of fire.

The New Usk Bridge. NEARLY three miles from the town of Usk, the river of the same name was formerly crossed by a picturesque suspension bridge with the span of about 150 ft. Owing to the insecurity of the structure for modern traffic requirements, the Monmouthshire County Council—in spite of strong local opposition—determined to replace the bridge by the steel arch which has recently been completed and opened for traffic. The disappearance of old landmarks is always regrettable, but in the present case we can scarcely blame the County Council, for the suspension bridge possessed no historic interest, and the work of repairing and strengthening it would have been neither economical nor satisfactory. The new bridge, which was designed by Mr. John J. Webster, is a two-hinged arch intersected near the abutments by the horizontal girders carrying the roadway, the central girder span being suspended below and the two outer spans supported above the arch ribs.

Movable Bridges. A RECENT paper by Mr. C. C. Schneider in the *Proceedings* of the American Society of Civil Engineers is one of exceptional value, not merely because of its evident merits, but also for the reason that it embodies the practical advice of an engineer who has had extended and varied experience in the design of almost every type of movable bridge now used in the United States. The paper contains a good review of the mechanical features of such structures, a set of specifications containing the author's views as to construction and workmanship, and a statement of the principles which he has followed in the design of such structures. Among the types briefly described are swing bridges rotating about a vertical axis, bascule bridges rotating about a horizontal axis or rolling upon a circular segment, traversing bridges moving horizontally forward and backward, lift bridges rising and falling vertically, and transporter bridges with a moving cage or platform. The selection of a type of movable bridge is necessarily governed by the special conditions of every individual case, but certain fundamental principles should always be borne in mind. These principles, as laid down by Mr. Schneider, are that when the bridge is closed each arm should act as nearly as possible like the spans of a stationary bridge, with operating machinery capable of being worked easily and only coming into service when the bridge is in motion. It is interesting to note that the preference shown by British engineers for the swing bridge is also shared by Mr. Schneider, this type being characterised by him as the best for long spans and the most economical of any for spanning two equal openings.

Dynamo Design. THE paper read by Messrs. Page and Hiss on "Direct Current Design as Influenced by Interpoles," to the Institution of Electrical Engineers last week, raises a question of great interest to electricians.

The use of turbines instead of reciprocating engines has created a demand for high-speed dynamos, and difficulties have been experienced owing to the excessive sparking at the commutator at these high speeds. To overcome this difficulty, "interpoles" have been adopted with great success in some cases. These poles are placed between the field magnet poles, and their function is to prevent the distortion of the magnetic field at heavy loads, and thus prevent sparking. The authors give no historical data, but we have found that this device was practically described in a patent filed in the United States as far back as July 19, 1884, by Mr. F. J. Sprague, and many machines designed on this principle were built by the original Sprague Electric Railway and Motor Company. This device then went out of practice for some fifteen years, but was revived in Germany a few years ago, owing to a demand which had arisen for high-pressure direct current motors for traction work. So successful has this device proved for this purpose that it may possibly in the immediate future revolutionise the methods of adapting electric traction for heavy traffic on main lines. There is always a danger in the introduction of novel methods that they will be applied in cases where the ordinary methods are more suitable. It seems to us that the value of this paper would be considerably increased if the authors had stated clearly the cases where the device would prove useful. They quote a long formula due to Dr. Breslauer to give the reactance voltage and a still longer one due to another author, but as in neither of the formulæ are all the symbols defined it is quite impossible to understand them. Simple empirical formulæ may sometimes prove useful to engineers, but lengthy complicated ones make too great demands on our credulity.

Bentley Priory, Stanmore, Middlesex.

THIS historical property, and its finely-timbered park of 300 acres, and Italian and cedar-tree gardens are offered for sale. The name is derived from a religious foundation which at the Suppression belonged to the monks of Lanfranc's Hospital, or Priory, of St. Gregory in Canterbury, and was given by Cranmer in exchange to Henry VIII. in 1543. Lanfranc built the original parish church of St. Mary, Harrow, *temp.* William I. Soane rebuilt the house for James Duberly, an army clothier and contractor, who sold the estate to the Marquis of Abercorn. Lord Abercorn collected there a valuable set of paintings by the old masters, with many portraits of the Hamiltons, and some choice examples of Sir Thomas Lawrence. His successor, the first Duke of Abercorn, lived at the Priory in 1832-40, and for him Sir Edwin Landseer painted his famous portrait-group. The Priory became what we may term the Holland House of the Tory Party in the time of the Regency, and was the scene of many fashionable and celebrated gatherings—amongst the visitors were Sir William Hamilton and Emma his wife, Pitt, Canning, Scott, Rogers, Lords Aberdeen and Liverpool, and the Duke of Wellington. It is said that portions of "Marmion" and of "Pleasures of Memory" were composed, or at any rate revised, there. Queen Adelaide leased the Priory in March, 1848, and died there in December, 1849. A few years afterwards, Sir John Kelk, the contractor, bought the house, to which he added the lofty campanile. Twenty years ago the Priory was taken for purposes of a "residential hotel." The grounds are beautifully situated, and rise to about 500 ft. above sea-level.

The New English Art Club.

THE first thing we set eyes on in the New English Art Club exhibition at Dering-yard (Bond-street) was a water-colour drawing, slight enough, of a white ship in blue water in a dock, which at once made us refer to the catalogue, where we read the title, "In a Levantine Port," with the name of John S. Sargent attached. There are two other small drawings of his along with it, but the important one is this large and wonderfully fine and vigorous architectural drawing, "A Balustrade" (74), with a great stone vase and other details; a work which shows that if Mr. Sargent is going to take to architectural subjects he will distance every one else in that line of work; this drawing by itself is really worth going to see. As for the rest, there is not much that is worth the effort; and what some of the prominent members of the club can put forth as art may be studied in such productions as those numbered 48 and 112. Professor Brown's half-length portrait of "An Amateur of Fencing" (82) has a crude vigour about it, as also Mr. Harrison's life-size "Portrait sketch" (144). What is it that people see to admire in Mr. Wilson Steer's life-size full-length of "Mrs. Hammersley"? (for it is apparent that there are people who admire it). We should call that also a life-size sketch—the crude foundation of a portrait, in which the face is perfectly hard and unfinished. There is an effect of light and air in Professor Brown's "The Mill" (67). M. Peart's "Consolation" (72) has the interest of being a realistic subject in which realism is evaded, to the advantage of its pathetic effect: in this respect it is a thing to be looked at. Mr. Jamieson's "Versailles" (91), part of the buildings towards the front courtyard, is not nearly so effective an architectural work as Mr. Sydney Lee's "The Roadside House" (101), though so much more important a subject; the latter has texture and daylight, which the "Versailles" wants. There are some good small landscape sketches.

The Fine Art Society.

M. LASZLO'S portraits at the Fine Art Society show a great deal of power of rendering expression, but they have no distinction of style, and can hardly merit higher praise than that of being interesting. In another room is a series of water-colours by Signor Onorato Carlandi under the title, "The Tiber, from its Source to the Sea." Though these are not in the hard and mechanical style which generally characterises what we call "topographical" water-colours, they belong more or less to that class; *i.e.*, they are of interest rather as representations of scenes than as examples of water-colour art, though some of them are effective enough. Considering that it is the river that gives the title to the collection, it is unfortunate that throughout the whole, the water is the part most weakly treated, or in some cases hardly treated at all.

ARCHITECTURE AT THE ROYAL ACADEMY.—IV.

AMONG the exhibits representing domestic and street architecture the first we come to is the coloured perspective view of Mr. Ricardo's now celebrated house in constructional polychromy, in Addison-road (1456), which is illustrated in a coloured perspective view of the exterior, and a view of the interior of one of the rooms with a domed ceiling on pendentives springing from large wall arches. There is a plan, but unfortunately too small for the names of the rooms to be discerned at the distance above the eye at which it is hung, so that we cannot tell what is the function of the low building on the right with a colonnaded portico and a pediment with the tympanum chequered in blue and white. As to the main house, we have already called attention to it as an effective and spirited effort at a new departure in the use of colour in external walls, while feeling at the same time that the treatment is not quite sufficiently domestic in character; the pilasters between which some of the windows are grouped give it too much the suggestion of being a small public library, or something of that kind. Mr. Ambrose Poynter's "Polesden Lacey" (1457) perhaps errs on the side of being too simple and unpretending for so large a house as the plan shows it to be; judging from the colouring of the elevations it would seem to be mainly rough-cast of slightly warm tint, with simply treated windows that are flanked by external green shutters in a manner more French than English, and which seem to be put there rather for effect than for necessity or use. The house is shown in two elevations and a plan of much larger scale than we generally find on a Royal Academy drawing. The plan is a good one, and the rooms are well placed as to aspect—dining-room and kitchen east, and drawing-room, boudoir, morning-room, and library south; the passage from the drawing-room door to the dining-room (past the hall) is by a columned corridor axial with the drawing-room door, and lighted from the centre-courtyard round which the house is mostly built. The kitchen window is on the wrong side of the fireplace—or, rather, the fireplace is on the wrong side of the window, for the fireplace could have been put the other side; and there seems to be an indication on the plan of sham window openings on the south side of the kitchen wall, which is a pity. But in the main this is a finely planned house, and the drawings are such as are the most suitable for the architectural room, where elevations and a good-sized plan are far more to the purpose than perspective pictures.

It is rather difficult to understand Messrs. Ernest George & Yeate's "Villa at Antibes" (1462), the perspective towards the fore-court makes it look so exceedingly like an old and weather-stained house, but the plan (to which there is no scale) seems to indicate that it is an entirely new house, not an old one added to. It is at all events very picturesque. The fore-court front has a large semicircular bay at each end, one of these forming the staircase, the other part of the drawing-room—the difference is suggested externally in the placing of the windows. The drawing-room ought to be a very interesting room, with its two square vestibules, one on each side of the bay, which projects out of it like the chancel of a Romanesque church. The sea front, of which a small elevation is given, shows an arcaded loggia on the ground floor connecting the drawing-room with the dining-room, and a columned loggia beneath the eaves above. It gives the idea of being a delightful house for a seaside residence in a warm climate.

Messrs. Oliver, Leeson, and Wood's "Interior of Hall for House in Northumberland" (1466) is a perspective view of a large hall with a first-floor gallery running round three sides of it, with balusters of a massive and distinctly *wooden* type, the bays divided by panelled pedestals carrying short columns; the fourth side of the hall, on the gallery level, appears to be filled up with a decorative

painting. This looks a good piece of work. There is a panelled plaster ceiling of segmental section.

A little pen-drawing of Mr. J. C. Carter's "Study for the Courtyard of the Gatehouse of the Monastery, Caldey Island" (1469) shows a very characteristic bit of simple masonry design, with large semicircular arches in the lower story filled up with rather massive tracery and narrow circular-headed windows above; there is a Romanesque feeling about it, and yet it is not mere imitation.

Messrs. Gruning & Mountford's "Northern Assurance Buildings" (1463: no plan) is a rather stately piece of street architecture, with a strongly rusticated arched ground story and an order of Ionic columns, stopped by pilasters, on each of the two faces, which are connected by a quadrant curve of more simply treated architecture. A strongly marked modillion cornice runs all round, above the order; the simple treatment of the two attic stories (the upper one set back) above the cornice, with the vertical pavilions capped by a curved pediment at each end, is good; the whole has the merit of being a stone design which is masonic in style.

Mr. C. H. Smith's "Hall of Residence, University College, Reading" (1477: no plan) is a bird's-eye view of a building of which we can only say that it looks very like a college, and has the usual form of collegiate gate-tower. "Dining-room, Cheswardine Hall, Salop" (1471), by Mr. Christian Elliot, is another wainscotted interior, with pilasters at intervals, well and correctly carried out, and shown in a good water-colour drawing, but, like the last-mentioned exhibit, without any special interest. Mr. Leonard Stokes's "National Telephone Exchange, Gerrard-street" (1478) gives us, as usual, something original and with a character of its own. It appears like an attempt to produce a front with a great deal of window area (for practical requirements) without taking to steel construction. In the ground story large circular arches with very deep reveals, and alternating brick and stone voussoirs, spring from stone plinth blocks; from these blocks rise piers with something of the appearance of mullions on a large scale, running up to the under side of the cornice; between these is as much window as possible, with (apparently) stone mullions. There is a doorway at each end, symmetrically treated with cornices and garlands. It is an interesting attempt to give a picturesque element to a building for practical purposes.

Mr. H. O. Creswell's "New Wing to Girls' School at Pinner" (1480) is a good piece of plain domestic Gothic with an arcaded and buttressed cloister; a plan is added, showing that the building is intended as a playroom below and an invalid ward above. Mr. Pearson's "St. Helen's School, Abingdon" (1488) is a bit of school architecture somewhat recalling the style of Mr. Robson's "London School Board Schools"; there is a plan, but it is too high to see.

Among the type of narrow London street fronts is Messrs. Treadwell & Martin's "3, Woodstock-street" (1498), a good stone treatment, and Mr. Vining's "Premises in Warwick-street" (1494), with a bay of semicircular plan supported on the ground floor cornice over the entrance, and supporting the balcony at the top, the balustrade of which is treated with some originality.

Mr. E. P. Warren's "Balliol College, Oxford; New building on St. Giles'" (1499: no plan) is disappointing; it is a rather bald stone elevation with a high-pitched pediment at the top and a circular window on the tympanum; it is a sober and sensible building, but we cannot say it is interesting. Professor Pite's "Assurance Office, Euston-square" (1500: no plan) is a remarkably bold conception in masonry design, which seems to have been influenced (and, if so, quite rightly) by the neighbourhood of the famous Euston Station portico; it is a great square block of building, with four Ionic columns on each face, which include two stories of the building; an orthodox cornice and attic over that, but another more salient cornice to the attic, above which is what one might call a second attic, with solid blocks at the angles and open loggie with small columns between. We really ought to have had a plan of each floor to see how it works out; but at all events it is a powerful and imposing piece of building.

Mr. Aickman's small house, "Middle Hill, Hook Heath" (1518) shows a well-arranged plan, and is a pleasant house in appearance—brick with tiled roof and rough-cast gables. Mr. Inigo Triggs' "House at Newport" (1527) is shown in a line perspective with a plan appended, which is rather defectively made out, however; the arrangement of the hall with canted angles in which are placed the doors to drawing-room and dining-room is good, but what is the space between the rooms, which seems to have no door? The design is a familiar form of half-timber work. Mr. W. R. Davidson's "House at Nairn" (1529) has an interesting plan, a centre with wings obliquely attached to it, and the interior arrangement cleverly fitted in. Messrs. Warwick & Hall's "Killyon Manor, County Meath" (1536) shows a symmetrical plan, with the dining-room and drawing-room forming similar projecting wings at each end of the front, and an open colonnade screening the front between them; the ball-room, which occupies one side of the back-portion of the plan, is arranged so as to be axial with the centre-line of the front and of the hall door; a point we note rather because we find plans in which axial arrangement of this kind is entirely ignored. Carrying the main cornice round the break in the front of each wing, and then round the curve of the bay, gives rather a disturbing series of lines; it would have been better if the circular bay had been stopped short with its own cornice.

In the large perspective drawing of "New Buildings, 160, Wardour-street" (1542) Mr. Pearson illustrates the first floor hall in Messrs. Novello's new premises; a fine apartment, lighted by large mullioned windows, and with some rich decorative treatment in the shape of wood-carving, the perforated panels of the doors, the carved marble mantel, and a sumptuous hanging chandelier in the centre. It is an excellent piece of work shown in an effective drawing. Mr. E. J. May's views of the hall and other interiors in a house in Kensington Palace Gardens were illustrated in our last issue, to which we may refer the reader.

Messrs. Tubbs & Messer's "Comeragh Court, Woking" (1539) is illustrated by two plans, and is a nice looking brick house with mullioned windows; but there are faults in the planning. Mr. Scorer's "A House in Holland" (1550: no plan) is a brick house with stone dressings, and that is all that one can say of it. Mr. Henry Tanner's "Crawley Grange" (1561) is an addition of a large wing, containing a ball-room, to an old house, and is illustrated by a plan between two small perspectives; the exterior on the ball-room side, with its three successive projecting bays, looks well, but in the plan the connexion and entrance to the ball-room is not well managed; and it is an odd instance of the careless way in which plans, even when introduced into Academy drawings, are prepared, that in the lavatory adjoining the ball-room the door has been forgotten in the plan, so that one cannot see how it is entered. The "Students' Union, University of Liverpool" (1568: no plan), by Professor Reilly, is a very effective and well-designed building, with a ground story in stone, a very broadly treated brick front over this, terminated by a large and strongly-marked white cornice, of what material is not quite apparent; but it is an original and effective building, illustrated in a very good water-colour drawing. A small pen drawing exhibits Mr. Mawson's design for "Lodge Entrance, Brookland Wood House, Baltimore" (1569); two square lodges with high roofs and projecting eaves, with a grille and gateway between; the flues in each lodge are collected in one central large circular funnel at the peak of the roofs; it may be a local method, but the appearance is ungainly.

This brings us to the centre line of the room, and we will defer further remarks to another issue.

INFANTS' SCHOOL, PONTYPRIDD.—A new infants' school, erected at a cost of 3,556*l.* 5s., on a site procured for 1,000*l.* by the Pontypridd Education Committee, was opened recently at Hawthorn, near Treforest. The new building is from the designs of Mr. P. R. A. Willoughby, Surveyor to the District Council, the contractor being Mr. J. E. Evans, Cardiff. Accommodation is provided for 250 children, and the building is of native stone, with red brick dressings, and includes a central hall, five classrooms, and two lobbies.

THE ROYAL INSTITUTE OF BRITISH ARCHITECTS.

THE usual fortnightly meeting of the Royal Institute of British Architects was held on Monday at the Rooms of the Institute, No. 9, Conduit-street, Mr. T. E. Collcutt, President, presiding.

Mr. Alexander Graham, Hon. Secretary, announced with regret the decease of the following members:—Mr. David Jenkins, elected an Associate in 1888, and a Fellow in 1894; Mr. William Hewson Lees, elected an Associate in 1865; Mr. Geo. Sanders, elected an Associate in 1865, and a Fellow in 1869; Mr. Walter Wood Robertson, elected a Fellow last December; and Sir Benjamin Baker, Hon. Associate, elected 1896.

The following report was then considered:—

PROVISIONAL REPORT OF THE COMMITTEE ON REINFORCED CONCRETE.

1. Reinforced concrete is used so much in building and engineering construction that a general agreement on the essential requirements of good work is desirable.

The proposals which follow are intended to embody these essentials, and to apply generally to all systems of reinforcement.

Good workmanship and materials are essential in reinforced concrete. With these and good design structures of this kind appear to be trustworthy. It is essential that the workmen employed should be skilled in this class of construction.

Very careful superintendence is required during the execution of the work in regard to:—

(*a*) The quality, testing, and mixing of the materials.

(*b*) The sizes and positions of the reinforcements.

(*c*) The construction and removal of centring.

(*d*) The laying of the material in place and the thorough punning of the concrete to ensure solidity and freedom from voids.

If the metal skeleton is properly coated with cement, and the concrete is solid and free from voids, there is no reason to fear decay of the reinforcement in concrete of stone, gravel, cinder, coke-breeze, etc., made with clean fresh water.

2. The by-laws regulating building in this country require external walls to be in brick, or stone, or concrete of certain specified thicknesses. In some places it is in the power of the local authorities to permit a reduced thickness of concrete when it is strengthened by metal; in other districts no such power has been retained. We are of opinion that all by-laws should be so altered as to expressly include reinforced concrete amongst the recognised forms of construction.

A section should be added to the by-laws declaring that when it is desired to erect buildings in reinforced concrete complete drawings showing all details of construction and the sizes and positions of reinforcing bars, a specification of the materials to be used and proportions of the concrete, and the necessary calculations of strength based on the rules contained in this report, signed by the person or persons responsible for the design and execution of the work, shall be submitted to and approved by the local authority.

3. *Fire Resistance.*—(*a*) Floors, walls, and other constructions in steel and concrete formed of incombustible materials prevent the spread of fire in varying degrees according to the composition of the concrete, the thickness of the parts, and the amount of cover given to the metal.

(*b*) Experiment and actual experience of fires show that concrete in which limestone is used for the aggregate is disintegrated, crumbles and loses coherence when subjected to very fierce fires, and that concretes of gravel or sandstones also suffer, but in a rather less degree.* The metal reinforcement in such cases generally retains the mass in position, but the strength of the part is so much diminished that it must be renewed.

Concrete in which coke-breeze, cinders or slag form the aggregate is only superficially injured, does not lose its strength, and in general may be repaired. Concrete of broken brick suffers more than cinder concrete and less than gravel or stone concrete.

(*c*) The material to be used in any given case should be governed by the amount of fire resistance required as well as by the cheapness of, or the facility of procuring, the aggregate.

(*d*) Rigidly attached web members, loose stirrups, bent-up rods, or similar means of connecting the metal in the lower or tension sides of beams or floor slabs (which sides suffer most injury in case of fire) with the upper or compression sides of beams or slabs not usually injured, are very desirable.

(*e*) For main beams a covering of 1½ in. to 2 in. of concrete over the metal reinforcement appears from experience in actual fires to afford ample protection to the structural parts. In floor

* The smaller the aggregate the less the injury.

slabs the cover required may be reduced to 1 in.

All angles should be rounded or splayed to prevent spalling off under heat.

(*f*) More perfect protection to the structure is required under very high temperature, and in the most severe conditions it is desirable to cover the concrete structure with fire-resisting plastering which may be easily renewed.

Columns may be covered with coke-breeze concrete, terra-cotta, or other fire-resisting facing.

Materials.

4. *Cement.*—Only Portland cement complying with the requirements of the specification adopted by the British Engineering Standards Committee should be employed; in general the slow-setting quality should be used. Every lot of cement delivered should be tested, and in addition the tests for soundness and time of setting, which can be made without expensive apparatus, should be applied frequently during construction.

The cement should be delivered on the work in bags or barrels bearing the maker's name and the weight of the cement contained.

5. *Sand.*—The sand should be composed of hard grains of various sizes up to particles which will pass a ¼-in. square mesh, but of which at least 75 per cent. should pass ⅛-in. square mesh. Fine sand alone is not so suitable, but the finer the sand the greater is the quantity of cement required for equal strength of mortar. It should be clean and free from ligneous, organic, or earthy matter. The value of a sand cannot always be judged from its appearance, and tests of the mortar prepared with the cement and the sand proposed should always be made. Washing sand does not always improve it, as the finer particles which may be of value to the compactness and solidity of the mortar are carried away in the process.

6. *Aggregate.*—The aggregate, consisting of gravel, hard stone, or other suitable material, should be clean and angular, varied in size as much as possible between the limits of size allowed for the work. In all cases material which passes a sieve of a ¼-in. square mesh should be reckoned as sand. The maximum allowable size is usually ¾-in. The maximum limit must always be such that the aggregate can pass between the reinforcing bares and between these and the centring.

The sand should be separated from the gravel or broken stone by screening before the materials are measured.

7. *Proportions of the Concrete.*—In all cases the proportions of the cement, sand, and aggregate should be separately specified in volumes.

As to the strength and durability of reinforced concrete structures depend mostly on the concrete being properly proportioned, it is desirable that in all important cases tests should be made as described herein with the actual materials that will be used in the work before the detailed designs for the work are prepared.

In no case should less dry cement be added to the sand when dry than will suffice to fill its interstices, but subject to that the proportions of the sand and cement should be settled with reference to the strength required, and the volume of mortar produced by the admixture of sand and cement in the proportions arranged should be ascertained.*

The interstices in the aggregate should be measured and at least sufficient mortar allowed to each volume of aggregate to fill the interstices and leave at least 10 per cent. surplus.

For ordinary work a proportion of one part of cement to two parts sand will be found to give a strong, practically watertight mortar, but where special watertightness or strength is required the proportion of cement must be increased.

The amount of cement added to the aggregate should be determined on the work by weight. The weight of a cubic foot of cement for the purpose of proportioning the amount of cement to be added may be taken at 90 lb.

8. *The metal* used should be steel having the following qualities:—

(*a*) An ultimate strength of not less than 60,000 lb. per square inch.

(*b*) An elastic limit of not less than 50 per cent., or more than 60 per cent. of the ultimate.

(*c*) An elongation of not less than 22 per cent. in the lengths stated below.

(*d*) It must stand bending cold 180 deg. to a diameter of the thickness of pieces tested without fracture on outside of bent portion.

In the case of round bars the elongation should not be less than 22 per cent., measured on a gauge-length of eight diameters. In the case of bars over 1 in. in diameter the elongation may be measured on a gauge-length of four diameters, and should then be not less than 27 per cent. For other sectional material the tensile and elongation tests should be those prescribed in the British Standard Specification for Structural Steel.

Before use in the work the metal must be clean and free from scale or loose rust. It should not be oiled or painted, but a wash of thick Portland cement grout is desirable.

Welding should in general be forbidden; if it is found necessary, it should be at points where the metal is least stressed, and it should never be allowed without the special sanction of the architect or engineer responsible for the design.

The reinforcement ought to be placed and kept exactly in the positions marked on the drawings, and, apart from any consideration of fire resistance, ought not to be nearer the surface of the concrete at any point than 1 in. in beams and ½ in. in floor slabs or other thin structures.

9. *Mixing: General.*—In all cases the concrete should be mixed in small batches and in accurate proportions, and should be laid as rapidly as possible.

Hand-mixing.—When the materials are mixed by hand they are to be turned over and thoroughly mixed on a clean platform until the colour of the cement is uniformly distributed over the aggregate.

Machine-mixing.—Whenever practicable the concrete should be mixed by machinery.

10. *Laying.*—The thickness of loose concrete that is to be punned should not exceed 3 in. before punning, especially in the vicinity of the reinforcing metal. Special care is to be taken to ensure perfect contact between the concrete and the reinforcement, and the punning to be continued till the concrete is thoroughly consolidated. Each section of concreting should be as far as possible completed in one operation; when this is impracticable, and work has to be recommenced on a recently-laid surface, it is necessary to wet the surface; and where it has hardened it must be hacked off, swept clean, and covered with cement grout. Work should not be carried on when the temperature is below 34 deg. F. The concrete when laid should be protected from the action of frost, and shielded against too rapid drying from exposure to the sun's rays or winds, and kept well wetted. All shaking and jarring must be avoided. The efficiency of the structure depends chiefly on the care with which the laying is done.

Water.—The amount of water to be added depends on the temperature at the time of mixing, the materials, and the state of these, and other factors, and no recommendation has therefore been made. Sea-water should not be used.

11. *Centring or Casing.*—The centring must be of such dimensions, and so constructed, as to remain rigid and unyielding during the laying and punning of the concrete. It must be so arranged as to permit of easing and removal without jarring the concrete. Provision should be made wherever practicable for splaying or rounding the angles of the concrete. Timber when used for centring may be advantageously limewashed before the concrete is deposited.

12. *Striking of Centres.*—The time during which the centres should remain up depends on various circumstances, such as the dimensions or thickness of the parts of the work, the amount of water used in mixing, the state of the weather during laying and setting, etc., and must be left to the judgment of the person responsible for the work. The casing for columns, for the sides of beams, and for the soffits of floor slabs not more than 4 ft. span must be removed under eight days; soffits of beams and of floors of greater span should remain up for at least fourteen days, and for large span arches for at least twenty-eight days. The centring of floors in buildings which are not loaded for some time after the removal of same may be removed in a short time; the centring for structures which are to be used as soon as completed must remain in place much longer. If frost occurs during setting, the time should be increased by the duration of the frost.

13. *Testing.*—Before the detailed designs for an important work are prepared, and during the execution of such a work, test pieces of concrete should be made from the cement, sand, and aggregate to be used in the work, mixed in the proportions specified. These pieces should be either cubes of not less than 4 in. each way, or cylinders not less than 4 in. diameter, and of a length not less than the diameter. They should be prepared in moulds, and punned as described for the work. Not less than four cubes or cylinders should be used for each test, which should be made twenty-eight days after moulding. The pieces should be tested by compression, the load being slowly and uniformly applied. The average of the results should be taken as the strength of the concrete for the purposes of calculation, and in the case of concrete made in proportions of 1 cement, 2 sand, 4 hard stone, the strength should not be less than 2,400 lb. per square inch.

Loading tests on the structure itself should not be made until at least two months have elapsed since the laying of the concrete. The test load should not exceed one and a half times the accidental load. Consideration must also be given to the action of the adjoining parts of the structure in cases of partial loading. In no case should any test load be allowed which would cause the stress in any part of the reinforcement to exceed two-thirds of that at which the steel reaches its elastic limit.

METHODS OF CALCULATION.

Data.

1. *Loads.*—In designing any structure there must be taken into account: (*a*) The weight of the structure; (*b*) any other permanent load, such as flooring, plaster, etc.; (*c*) the accidental load *; (*d*) in some cases also an allowance for vibration and shock.

Of all probable distributions of the load, that is to be assumed in calculation which will cause the greatest straining action.

(1) The weight of the concrete and steel structure may be taken at 150 lb. per cubic foot.

(2) In structures subjected to very varying loads and more or less vibration and shock as, for instance, the floors of public halls, factories, or workshops, the allowance for shock may be taken equal to half the accidental load. In structures subjected to considerable vibration and shock, such as floors carrying machinery, the roofs of vaults under passage ways, and courtyards, the allowance for shock may be taken equal to the accidental load.

(3) In the case of columns or piers in buildings, which support three or more floors, the load at different levels may be estimated in this way. For the part of the roof or top floor supported, the full accidental load assumed for the floor and roof is to be taken. For the next floor below the top floor 10 per cent. less than the accidental load assumed for that floor. For the next floor 20 per cent. less, and so on to the floor at which the reduction amounts to 50 per cent. of the assumed load on the floor. For all lower floors the accidental load on the columns may be taken at 50 per cent. of the loads assumed in calculating those floors.

Beams.

2. *Spans.*—These may be taken as follows:—For beams the distance from centre to centre of bearings. For slabs supported at the ends, the clear span + the thickness of slab. For slabs continuous over more than one span the distance from centre to centre of beams.

3. *Bending moments.*—In the most ordinary case of a uniformly distributed load of w lb. per inch run of span the bending moments will be as follows:—

(*a*) *Beam or slab simply supported at the ends.*—Greatest bending moment at centre of span of l in. is equal to $wl^2/8$ in. lb.

(*b*) *Beam continuous over several spans, or encastré or fixed in direction at each end.*—The greatest bending moments are at the ends of the span, and the beam should be reinforced at its upper side near the ends. If continuity can be perfectly relied on, the bending moment at the centre of the span is $wl^2/24$, and that over the supports $= -wl^2/12$. If the continuity is in any way imperfect, the bending moment at the centre will in general be greater, and that at the supports less, but the case is a very indefinite one. It appears desirable that generally in building construction the centre bending moment should not be taken less than $wl^2/12$. The bending moment at the ends depends greatly on the fixedness of the ends in level and direction. When continuity and fixing of the ends, whether perfect or imperfect, is allowed for in determining the bending moment near the middle of the span, the beam or slab must be designed and reinforced to resist the corresponding bending moments at the ends.

When the load is not uniformly distributed the bending moments must be calculated on the ordinary statical principles.

4. *Stresses.*—The internal stresses are determined as in the case of a homogeneous beam, on these approximate assumptions:—

(*a*) The coefficient of elasticity in compression of stone or gravel concrete, not weaker than 1 : 2 : 4, is treated as constant and taken at one-fifteenth of the coefficient of elasticity of steel.

Lb. per sq. in.

Coefficient for concrete $= E_c = 2{,}000{,}000$

" " steel $= E_s = 30{,}000{,}000$

$$\frac{E_s}{E_c} = 15.$$

It follows that at any given distance from the neutral axis, the stress per square inch on steel will be fifteen times as great as on concrete.

* For convenience on small works the following figures may be taken as a guide, and are probably approximately correct for medium silicious sand:—

Parts Cement.		Parts Sand.		Parts Mortar.
1	+	½	=	1·20
1	+	1	=	1·50
1	+	1½	=	1·90
1	+	2	=	2·35
1	+	2½	=	2·70
1	+	3	=	3·00

* By accidental load is meant the imposed load additional to the weight of the structure for which the structure is calculated.

(*b*) The resistance of concrete to tension is neglected, and the steel reinforcement is assumed to carry all the tension.

(*c*) The stress on the steel reinforcement is taken as uniform on a cross-section, and that on the concrete as uniformly varying.

5. *Working stresses.*—If the concrete is of such a quality that its crushing strength is 2,400 to 3,000 lb. per square inch after twenty-eight days, and the steel has a tenacity of not less than 60,000 lb. per square inch, the following stresses may be allowed :—

	Lb. per sq. in.
Concrete, in compression in beams subjected to bending.....	600
Concrete in columns under simple compression	500
Concrete in shear in beams	60
Adhesion* of concrete to metal ..	100
Steel in tension	15,000 to 17,000

When the proportions of the concrete differ from those stated above the stress in compression allowed in beams may be taken at one-fourth, and that in columns at one-fifth of the crushing stress of cubes of the concrete of sufficient size at twenty-eight days after gauging. If stronger steel is used than that stated above, the allowable tensile stress may be taken at one-half the stress at the yield point of the steel.

Approximate Calculations.

Let b be the width and d the effective depth of the beam in inches.

$A = bd$ the area of cross-section.

$m = E_s / E_c$ the ratio of the coefficients of elasticity of steel and concrete.

M = bending moment at the section considered, in inch-pound units.

t = tensile stress in metal in pounds per square inch.

c = compressive stress in concrete per square inch.

z = distance of resultant thrust in concrete from compressed edge of beam in inches.

kd = distance of neutral axis from compressed edge in inches.

$A_{cl} = kbd$ = area of concrete in compression in square inches.

A_t = area of metal in tension in square inches.

$p = A_t / bd$ the ratio of section of metal to section of concrete.

l = span in inches.

w = load per inch run of span.

(*a*) *Beams of rectangular section with single reinforcement.*

In a homogeneous beam the stresses are proportional to the distances from the neutral axis. In a discrete beam, such as a beam of concrete and steel, on account of the greater rigidity of steel, at a given distance from the neutral axis the stress in the steel will be m times as great as in concrete. Hence :—

$$\frac{mc}{t} = \frac{kd}{d(1-k)} = \frac{k}{1-k}$$

But equating the total tension and compression

$$\tfrac{1}{2}\, cbkd = pbdt.$$
$$ck = 2\,pt.$$

Replacing c in terms of t

$$\frac{k^2}{m(1-k)} = 2p$$
$$k = \sqrt{(p^2m^2 + 2pm)} - pm.$$

Thus for

$m =$	$p =$	$k =$
15	·007	·365
15	·010	·417
15	·015	·483
15	·020	·530

That is, the neutral axis is lower as the amount of reinforcement is greater, and passes the half depth for 2 per cent. of reinforcement.

The distance of the resultant thrust from the compressed edge is

$$z = \tfrac{1}{3}kd.$$

Equating the moments of resistance to the bending moment,

$$M = A_t t\,(d - \tfrac{1}{3}kd) = \tfrac{1}{2}A_c c\,(d - \tfrac{1}{3}kd)$$
$$t = \frac{M}{A_t d\,(1 - \frac{1}{3}k)} = \frac{M}{pbd^2\,(1 - \frac{1}{3}k)}$$
$$c = \frac{2M}{A_c d\,(1 - \frac{1}{3}k)} = \frac{2M}{kbd^2\,(1 - \frac{1}{3}k)}$$

The shearing stresses and tensions near the ends of the beam are usually resisted by stirrups or inclined steel bars, and it is always desirable to bend upwards near the supports one or more of the reinforcing bars when the reduced bending moments at the ends permit of so doing. Stirrups or rigdily attached web members or inclined bars should be provided in all cases where the average shearing stress on a vertical section of the beam exceeds 60 lb. per square inch of the section. A theoretical determination of the section required for these would be very difficult. If the simple case is taken of a uniformly loaded beam, supported at the ends with horizontal steel tension bars not bent up at the ends, the adhesion between concrete and steel which is required may be found thus : The difference of tension in 1-ft. length of bars at the end of the span will be the tangential force between steel and concrete in that distance. The bending moment at the end is 0, and at 1 ft. from the end $6w\ (l - 12)$ inch-pounds, where w is the load per inch run. Hence the increment of tension between the end and 1 ft. from the end is

$$\frac{6w(l-12)}{d(1-\frac{1}{3}k)} \text{ lb.}$$

If ψ is the total perimeter of the reinforcing bars, the adhesion stress is

$$\frac{w\,(l-12)}{2\psi d\,(1-\frac{1}{3}k)} \text{ lb. per sq. in.}$$

(*b*) *Beams of* T *section with single reinforcement.*

In designing T beams where the upper flange forms a floor, the thickness d_1 of this will first be ascertained by considering the part between two ribs as a slab, having its own reinforcing bars transverse to the rib. The whole of this cannot in general be considered to form part of the upper flanges of the T beams. The width b_1 of the upper flange may be assumed to be not greater than one-third the span of the beams, or than three-fourths of the distance from centre to centre of the reinforced ribs.* The depth d should then be determined with reference to the stiffness required in the floor. In general d is from $\frac{1}{11}$th to $\frac{1}{15}$th of the span.

Two cases arise according as the thickness of flange is greater or less than kd, the distance from the neutral axis to the compressed edge. In the former case ($d_1 > kd$) the rules under (*a*) apply if b_1 is substituted for b, and $A = b_1 d_1 + b\,(d - d_1)$ for bd. The equations then become

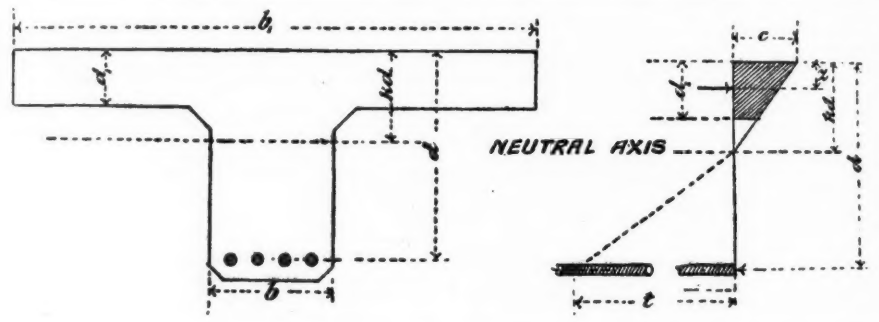
$$\frac{mc}{t} = \frac{k}{1-k}$$
$$k = \sqrt{\left(\frac{2pAm}{b_1 d} + \frac{p^2A^2m^2}{b_1^2 d^2}\right)} - \frac{pAm}{b_1 d}$$
$$= \sqrt{\left(\frac{2A_t m}{b_1 d} + \frac{A_t^2 m^2}{b_1^2 d_1^2}\right)} - \frac{A_t m}{b_1 d}$$
$$z = \tfrac{1}{3}kd$$
$$t = \frac{M}{A_t d\,(1 - \frac{1}{3}k)} = \frac{M}{pAd\,(1 - \frac{1}{3}k)}$$
$$c = \frac{2M}{A_c d\,(1 - \frac{1}{3}k)} = \frac{2M}{kb_1 d^2\,(1 - \frac{1}{3}k)}$$

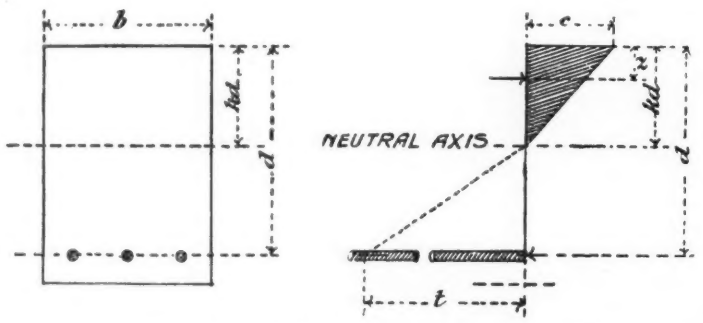
where $pA = A_t$ the section of reinforcement. The increment of tension in 1 ft. length at the end of the beam and the adhesion stress is the same as in (*a*).

When d_1 is less than kd the small compression in the web between d_1 and kd may be neglected.

Let, as before, the whole area of section $= A = b_1 d_1 + b(d - d_1)$, and pA be the area of reinforcement.

$$\frac{mc}{t} = \frac{k}{1-k}$$





The mean compressive stress on the flange is

$$\tfrac{1}{2}\left\{c + c\,\frac{kd - d_1}{kd}\right\} = \frac{c}{2}\,\frac{2kd - d_1}{kd}$$

Equating the total tension and compression,

$$A_t t = pAt = \tfrac{1}{2}b_1 d_1 c\,\frac{2kd - d_1}{kd}$$
$$kd = \frac{b_1d_1^2 + 2pAmd}{2b_1d_1 + 2pAm} = \frac{b_1d_1^2 + 2A_t md}{2b_1d_1 + 2A\,m}$$
$$\text{But } z = \frac{d_1}{3}\cdot\frac{3kd - 2d_1}{2kd - d_1}$$

Equating the moments

$$M = A_t t(d - z) = pAt(d - z) = \tfrac{1}{2}b_1 d_1 c\,\frac{2kd - d_1}{kd}\,(d - z)$$
$$t = \frac{M}{pA\,(d - z)}$$
$$c = \frac{2Mkd}{b_1 d_1\,(2kd - d_1)\,(d - z)}$$

It may be useful also to point out that the area of reinforcement for a given value of c/t is

$$A_t = pA = \frac{c}{t}\cdot\frac{b_1 d_1\,(2kd - d_1)}{2kd}$$

(*c*) *Slabs supported or fixed on more than two sides.*

It does not appear that there is either a satisfactory theory or trustworthy experiments from which the strength of rectangular slabs supported or fixed on all four edges can be determined.

[See Appendices for a statement of some rules which have been used in determining the strength of slabs.]

Columns or Pieces Subjected to Thrust.

The reinforcement of columns should in general amount to at least 0·8 per cent. of the gross cross-section. The liability to bending of the longitudinal reinforcing bars greatly weakens the column, and should be prevented by steel binding bars. Some theoretical considerations would indicate that cross binding is required at points not further apart than twenty-four times the least lateral dimension of the reinforcing rods. But experiment shows that still closer cross binding, or better, spiral binding,* greatly increases the strength of the column.

(*a*) *Short columns axially loaded.*

If the load is strictly axial the stress is uniform on cross-sections. Let A_c be the cross-section of the column (including the reinforcement), and A the equivalent section as defined below,

* It is desirable that the reinforcing rods should be so designed that the adhesion is sufficient to resist the shear between the metal and concrete. Precautions should in every case be taken by splitting or bending the rod ends, or otherwise to provide additional security against the sliding of the rods in the concrete.

* There is no satisfactory theoretical determination of the precise amount of the floor slab acting with the web.

* M. Considère recommends that the distance between the coils of the spiral should not exceed from $\frac{1}{10}$th to $\frac{1}{7}$th of the diameter of the spiral. In the case of piles subjected to longitudinal shock in driving there are special reasons for decreasing the distance between the cross binding near the ends.

a the section of longitudinal reinforcing bars, P the load on the column in pounds. Let c be the stress on the concrete, and t that on the steel, the ratio of the coefficients of elasticity being m.

$$c = \frac{P}{A_c + (m-1)a} = \frac{P}{A}$$

$$t = \frac{mP}{A_c + (m-1)a} = \frac{mP}{A}$$

It appears that c may be taken = 500 lb. per square inch, t = 7,500 lb. per square inch, and $E_s / E_c = m = 15$.

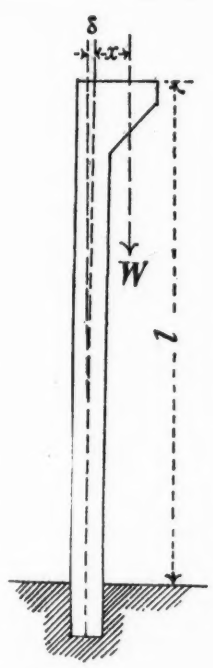
When the stress on the concrete is not greater than 500 lb. per square inch, lateral bending of the column as a whole is not to be feared if the ratio of length to the least lateral dimension is not greater than 18.

(b) Columns eccentrically loaded.

If a column initially straight is loaded eccentrically, as when a beam rests on a bracket attached to the column, it may be regarded as fixed at the base and free at the loaded end. Then it must bend in the plane passing through the load, the deflection at the top being δ. Let x be the eccentricity of the load measured from the centre of the column when straight. Then the bending moment at the base of the column is $W(\delta + x)$. But it is known that δ will be small compared with x, provided that W is small compared with $2EI/l^2$, and this will be the case in such conditions as are likely to occur in designing concrete columns. Then the bending moment may be taken as Wx, and the stress at the base of the column, treating it as homogeneous, will be :—

$$f = W\left\{\frac{1}{A} \pm \frac{x}{Z}\right\}$$

very nearly, where A is the whole section of the column and Z the modulus of the section relatively to an axis through the centre of gravity and at right angles to the plane of bending.



In dealing with reinforced columns which are not homogeneous, it is convenient to substitute for the actual section of the column what may be termed the equivalent section, or section of concrete equivalent in resistance to the actual column. If A_c is the area of section of the column (including the area of reinforcement), and a is the area of reinforcement, then the equivalent section is

$$A = A_c + (m-1)\,a.$$

If h is the depth of the section in the plane of bending, the moment of inertia relatively to the neutral axis can be expressed in the form $I = nAh^2$, and the section modulus in the form $Z = \frac{1}{n}Ah$. (See Appendix III.)

It is desirable in columns that there should be no tension, and generally when the vertical load is considerable there is none. Cases in which the eccentricity is so great that there is tension must be treated by the methods applicable to beams if it is made a condition that the steel carries all the tension. In the following cases it is assumed that there is no tension.

Case I.—Column of circular section, reinforced symmetrically to the neutral axis.—Let m be the ratio E_s/E_c of the coefficients of elasticity of steel and concrete, A_c the cross-section of the column in square inches, a the area of reinforcement in square inches, h the diameter of the column, h_t the distance between the reinforcing bars perpendicular to the neutral axis. Then the equivalent section is

$$A = A_c + (m-1)\,a$$

and the modulus of the section is (Appendix III.)

$$Z = \tfrac{1}{8}A_c h + \tfrac{1}{2}(m-1)\,a\frac{h_t^2}{h}$$

The stresses at the edges of the section can then be calculated by the general equation

$$f = W\left\{\frac{1}{A} \pm \frac{x}{Z}\right\}$$

where x is the eccentricity of the load in inches and W the load in pounds. The greater value of f must not exceed the safe stress stated above.

Case II.—Rectangular section with reinforcement symmetrical to the neutral axis.—Using the same notation as in the last case, h being now the depth of the section in the plane of bending, the section modulus is (Appendix III.).

$$Z = \tfrac{1}{8}A_c h + \tfrac{1}{2}(m-1)\,a\frac{h_t^2}{h}$$

and the stresses are given by the same equation as in the previous case.

Case III.—Column of circular section with reinforcing bars arranged in a circle.—Using the same notation as in Case I., h_t being the diameter of the circle of reinforcing bars, the section modulus is (Appendix III.)

$$Z = \tfrac{1}{8}A_c h + \tfrac{1}{10}(m-1)\,a\frac{h_t^2}{h}$$

and the stresses are given by the same equation as in Case I.

(c) Long columns axially loaded.

For columns more than 18 diameters in length there is risk of lateral buckling of the column as a whole. The strength of such columns would be best calculated by Gordon's formula, but there are no experiments on long columns by which to test the values of the constants for a concrete or concrete and steel column. There does not seem, however, to be any probability of serious error if the total load is reduced in a proportion inferred from Gordon's formula to allow for the risk of buckling.

Let, as before, A_c = the section of the column in inches ; a = the area of reinforcement. Then $A = A_c + (m-1)\,a$ is the equivalent section. Let n be the constant in the equation, $I = nAh^2$ (Appendix III.), and h the least transverse dimension of the column.

Then for a column fixed in direction at both ends, Gordon's formula is

$$\frac{W}{Af} = \frac{1}{1 + \frac{l^2}{cnh^2}} = \frac{1}{1+K}$$

so that the column will carry less than a short column of the same dimensions in the ratio of 1 + K to 1, or, in other words, the column will be safe if calculated as a short column, not for the actual load W, but for a load (1 + K) W.

The constant c has not been determined experimentally for reinforced long columns. But its probable value is

$$c = \frac{4\pi^2 E_c}{f}$$

where f is the ultimate crushing stress. Putting E_c = 2,000,000 and f = 2,500, then c = 32,000. Looking at the well-understood uncertainty of the rules for long columns, very exact calculation is useless. Some values of n for ordinary types of column are given in Appendix III. Taking these values, the following are the values of 1 + K :—

VALUES OF 1 + K.

$\frac{l}{h}$	*Case I.* $n = 0{\cdot}098$	*Case II.* $n = 0{\cdot}075$	*Case III.* $n = 0{\cdot}0646$
20	1·13	1·17	1·19
25	1·20	1·26	1·30
30	1·29	1·38	1·44

The difference of 1 + K for considerable differences of n are not very great. In any case n can be found by the method in the Appendix with little trouble.

In the case of columns fixed at one end and rounded or unfixed at the other, 2K must be substituted for K. If the column is rounded at both ends, 4K must be substituted for K.

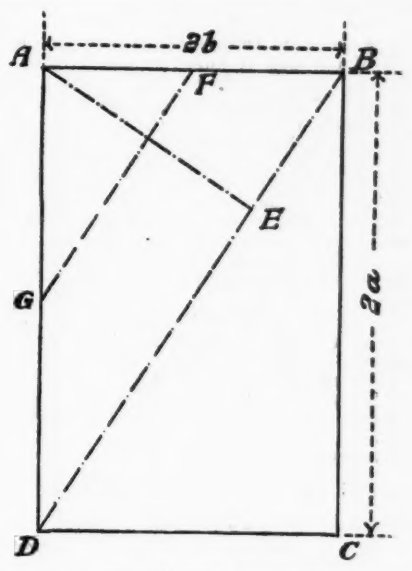
Appendix I.

Bach's Theory of the Resistance of Flat Slabs Supported on all Edges and Uniformly Loaded.

By Professor W. C. Unwin.

The experiments of Professor Bach show that a flat square slab supported all round fractures along a diagonal, and the greatest stress is therefore on the diagonal section. It is the same apparently with rectangular slabs, though the evidence is not quite so clear. But if a diagonal fracture is assumed a very simple theory gives the stress.

Let the figure represent a rectangular slab with sides $2a$ and $2b$ in inches. Let the diagonal B D = d ; the thickness of the slab = h ; the perpendicular on the diagonal A E = c ; draw F G bisecting the sides and let p be the load per square inch. Consider the left-hand half of the rectangle. The total load on it is $2pab$ acting at the centre of gravity of A B D or at $c/3$ from the diagonal. Whatever the distribution of the



reactions of the supports, from symmetry, the reaction on A B must act at the centre F of A B and the reaction on A D must act at the centre G of A D. Hence the resultant of the reactions on A B, A D = $2pab$ must act at some point on the line F G or at a distance $c/2$ from the diagonal. Hence the bending moment on the diagonal section is

$$M = 2pab\left(\frac{c}{2} - \frac{c}{3}\right) = \frac{pabc}{3},$$

the stress at the diagonal section is

$$f = \frac{6M}{dh^2} = 2p\,\frac{abc}{dh^2}$$

But $cd = 4ab$,

$$d^2 = 4a^2 + 4b^2,$$

$$f = 2p\,\frac{a^2}{a^2 + b^2}\,\frac{b^2}{h^2}$$

The following form of the equation is convenient :—

$$f = \tfrac{1}{2}\,\frac{\left(\frac{a}{b}\right)^2}{\left\{1 + \left(\frac{a}{b}\right)^2\right\}\frac{a}{b}}\,\frac{W}{h^2}$$

Where W is the total load on the slab.

$\frac{a}{b}$ =	f =
1	$0{\cdot}25\,\frac{W}{h^2}$
1·5	$0{\cdot}23\,\frac{W}{h^2}$
2	$0{\cdot}20\,\frac{W}{h^2}$

It would seem that if Bach's formula is to be used in calculating slabs, the reinforcing rods should be perpendicular to the diagonals of the rectangle.

Appendix II.

Comparison of the Results given by Various Rules for the Strength of Flat Rectangular Slabs Supported on all Edges and Uniformly Loaded.

By Mr. William Dunn.

The theories of Professor Grashof and of Professor Rankine assume that the maximum bending stress on the slab is at the centre, where there are two principal stresses on planes normal to each other, these planes coinciding with the major and minor axes of the slab.

The stress on the plane formed by the major axis of the slab (which is the greater of the two principal stresses) may be found in a simple manner as follows :—

Let the length of the slab = a, and the breadth = b (where a is equal to or greater than b).

Calculate the bending moment on the slab (disregarding the end supports) as a beam supported or fixed at the sides only, of a span b under the total load on the slab. Multiply this bending moment by the factor s in the following table, to allow for the effect of the end supports. The result is the actual bending moment on the long axis of the slab.

When $\frac{a}{b}$ =	Grashof's and Rankine's Rule.		French Government Rule.	
	$s = \frac{a^4}{a^4 + b^4}$	$r = \frac{b^4}{a^4 + b^4}$	$s = \frac{1}{1 + 2\frac{b^4}{a^4}}$	$r = \frac{1}{1 + 2\frac{a^4}{b^4}}$
1·0	0·50	0·50	0·33	0·33
1·5	0·83	0·16	0·71	0 09
2·0	0·94	0·05	0·89	0·03

The stress on the section formed by the long axis of the slab is found in the usual way by equating this actual bending moment to the moment of resistance of that section.

Similarly the stress on the plane formed by the minor axis of the slab is found by assuming the slab supported or fixed at the ends (disregarding the effect of the side supports), calculating the bending moment as if the slab were a beam of span a under the total load on the slab. Reduce the bending moment so found by the factor r in the table above, and the result is the actual bending moment on the short axis of the slab.

The stress on the section formed by that axis is found as before by equating this moment to the moment of resistance of that section.

The reasoning by which we find the factors s and r is not entirely satisfactory, and other writers ive other values. In the Instructions issued by the French Government to the Ingénieurs des Ponts et Chaussées with the Report of the Ministerial Commission du Ciment Armé the factors adopted give a greater importance to the effects of the third and fourth supports. The values of s and r, according to that report, are also given in the table above.

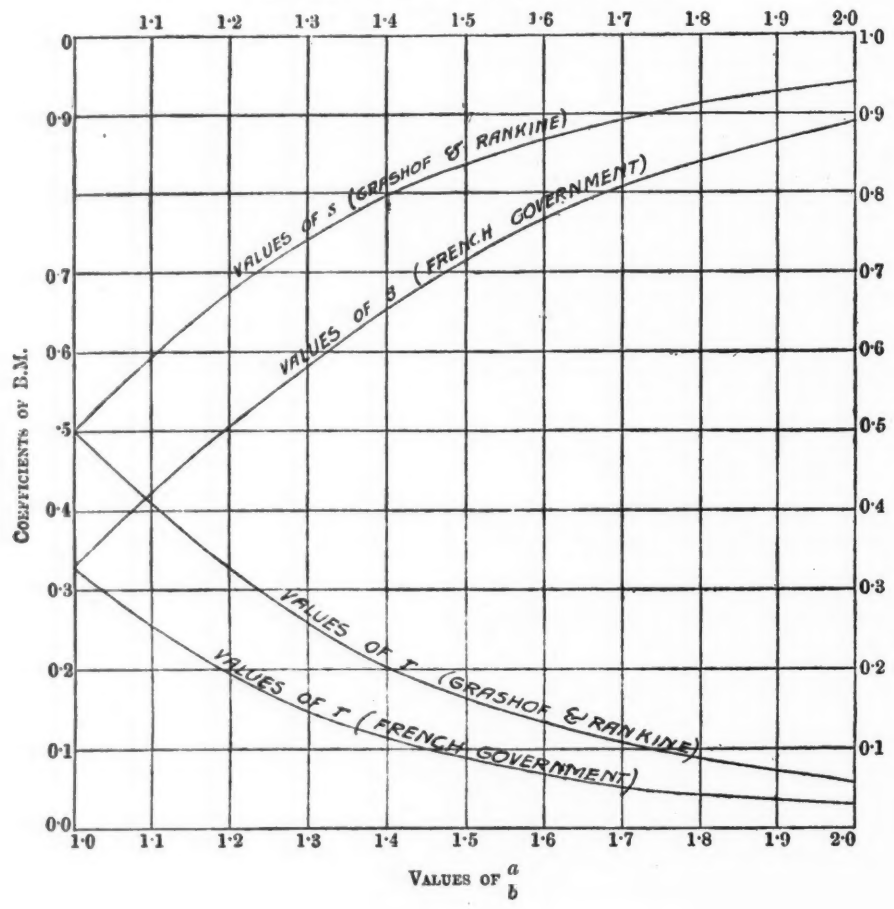
The maximum stresses on the sections as found by the foregoing rules when the slab is supported but not fixed all round are given in the table below, W being the total load uniformly distributed over the slab, h its thickness, and f the maximum stress due to bending.

These results may be more readily compared by the diagram given below.

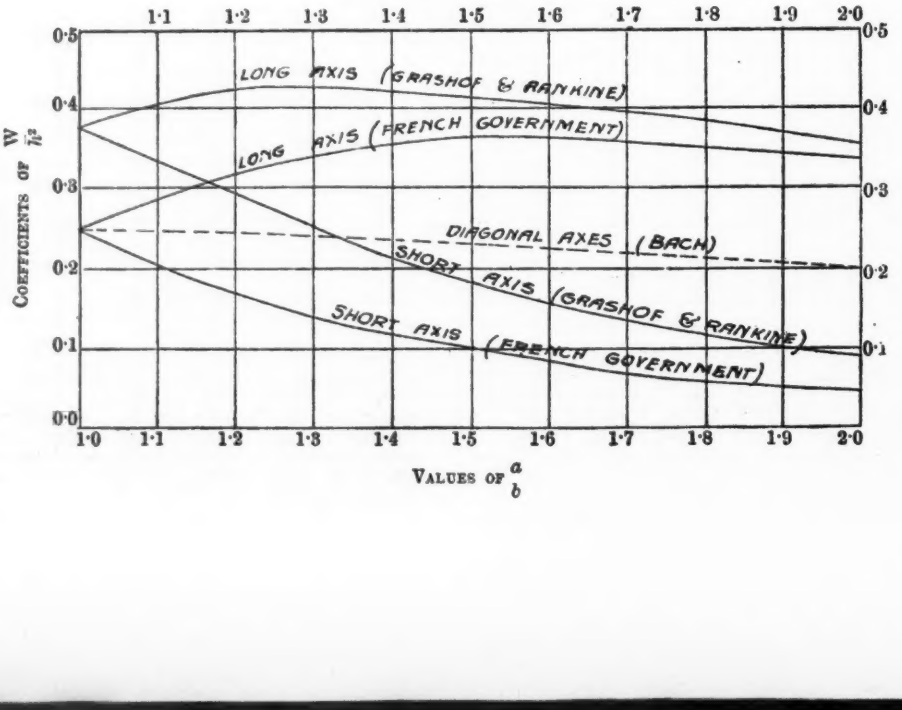
It is implicitly assumed in the foregoing that the strength to resist bending is the same in both directions, so that the reinforcements longitudinal and transverse should be of equal area and at the same depth from the compressed face:

When $\frac{a}{b}$ =	Values of f according to Grashof and Rankine.		Values of f according to French Government Rule.	
	On Long Axis.	On Short Axis.	On Long Axis.	On Short Axis.
1·0	$0{\cdot}375\frac{W}{h^2}$	$0{\cdot}375\frac{W}{h^2}$	$0{\cdot}250\frac{W}{h^2}$	$0{\cdot}250\frac{W}{h^2}$
1·5	$0{\cdot}416\frac{W}{h^2}$	$0{\cdot}183\frac{W}{h^2}$	$0{\cdot}361\frac{W}{h^2}$	$0{\cdot}101\frac{W}{h^2}$
2·0	$0{\cdot}352\frac{W}{h^2}$	$0{\cdot}088\frac{W}{h^2}$	$0{\cdot}333\frac{W}{h^2}$	$0{\cdot}045\frac{W}{h^2}$

BENDING MOMENTS (Supported or Fixed).


1·1 1·2 1·3 1·4 1·5 1·6 1·7 1·8 1·9 2·0
0 0·9 0·8 0·7 0·6 0·5 0·4 0·3 0·2 0·1 0·0
VALUES OF s (GRASHOF & RANKINE)
VALUES OF s (FRENCH GOVERNMENT)
VALUES OF r (GRASHOF & RANKINE)
VALUES OF r (FRENCH GOVERNMENT)
COEFFICIENTS OF B.M.
VALUES OF a/b

STRESSES (Supported only).


1·1 1·2 1·3 1·4 1·5 1·6 1·7 1·8 1·9 2·0
0·5 0·4 0·3 0·2 0·1 0·0
LONG AXIS (GRASHOF & RANKINE)
LONG AXIS (FRENCH GOVERNMENT)
DIAGONAL AXES (BACH)
SHORT AXIS (GRASHOF & RANKINE)
SHORT AXIS (FRENCH GOVERNMENT)
COEFFICIENTS OF W/h²
VALUES OF a/b

they should be placed parallel to the ends and sides.

The stresses found by Bach's formula are also plotted on the diagram.

[The remainder of this report, consisting of Appendix III. by Professor W. C. Unwin, and Appendix IV. by Mr. William Dunn, will be given in our next issue.]

The following is a list of members of the Concrete Committee and the various bodies represented:—Sir Henry Tanner, I.S.O. (Chairman), T. Walmisley, M.Inst.C.E., William Dunn, Max Clarke, and H. D. Searles-Wood (Hon. Sec.), representing the Royal Institute of British Architects; Thomas Henry Watson and E. Dru Drury, representing the District Surveyors' Association; Benjamin I. Greenwood and Frank May, J.P., representing the Institute of Builders; A. E. Collins, M.Inst.C.E., and J. W. Cockrill, M.Inst.C.E., representing the Municipal and County Engineers' Association; Colonel C. B. Mayne, R.E. (Vice-Chairman), and Major E. M. Paul, R.E., representing the War Office; C. H. Colson, M.Inst.C.E., representing the Admiralty; Professor W. C. Unwin, F.R.S. (Vice-Chairman), Charles F. Marsh, M.Inst.C.E., M.Am.Soc.C.E., and Colonel F. Winn, R.E.

Sir Henry Tanner (Chairman of the Joint Committee on Reinforced Concrete), in moving the adoption of the report of the Committee, said the Committee was formed on the recommendation of the Science Standing Committee of the Institute in October, 1905. In forming the Committee the Institute very wisely decided that other bodies to whom reinforced concrete was of interest should be invited to take part in the work, and thus ensure that the report and rules which might be prepared should be considered from all points of view. The Admiralty, War Office, Municipal and County Surveyors, District Surveyors, and the Institute of Builders were all represented, as well as the Royal Institute of British Architects. The reference to the Committee was in the following terms:—"To draw up rules for the guidance of architects and for the use of reinforced concrete." The result of the Committee's deliberations was in the provisional report, which it was hoped would be adopted that night. There had not been hitherto in this country any authoritative pronouncement on the necessary rules to be observed in such construction. In many ways this had prevented the employment of reinforced concrete, such employment being practically prohibited for complete buildings under the ordinary building rules and regulations; and it was only those bodies who were free from these restrictions, such as railway and dock companies, who had been able to avail themselves of so economical and space-saving a method of construction, and on those points he spoke from experience. Other countries had been more lenient, and in consequence those countries were far in advance of this both as to general knowledge of the material and skill in its use. However, they hoped that if the meeting adopted the rules which had been prepared, this country might not for long occupy the backward position that it now did. It

was found desirable to form sub-committees for the consideration of special branches of the subject, and these were three in number, viz.:—(1) Fire-resistance, Mr. T. H. Watson, Chairman; (2) Materials, Col. Mayne, R.E., Chairman; and (3) Formulæ, Professor Unwin, Chairman. These Committees had to consider an enormous mass of literature, including the regulations in force in other countries, and only those who had studied the subject were aware of the innumerable experiments, theories, writings, and reports of discussions which were available. To begin with, Messrs. Cubitt kindly put at the disposal of the Committee seventeen beams, plain and reinforced, for testing to destruction, the direction of the tests being undertaken by Professor Unwin. These were the only tests made under the supervision of the Committee, it being found that the available records of all kinds of accurately tabulated tests by various public authorities, technical colleges, and other bodies had largely removed the material from the unknown, and that what was required was rather a reasoned theory based on the recorded experiments than on a further series of experiments of their own, the latter, indeed, being beyond the means at their command. There were, of course, various disputed points which must be settled by further experiment, such as the width of flange in T-beams, but to these the report drew attention without laying down definite rules. The aim of the Committee had been the production of a good working guide, the laying down of the necessary conditions, and settling safe rules for a proper disposition of the parts. Hitherto every specialist in this country had made his own rules, perhaps more or less approximately accurate, but the margin of safety had been occasionally cut too fine. It should not be enough that a structure bore its working load without apparent distress, because a specially well-made floor might stand loads far beyond the average without breaking down; but they had to provide such a margin of safety as would cover ordinary inattention or ordinary defects of workmanship. The difficulty had been to determine the merits of rival systems, each specialist naturally regarding his own system as the best; but the report and rules before them would enable an accurate judgment to be arrived at by the architect himself if he had the requisite knowledge, or with the aid of a consulting engineer if he preferred. The rules proposed were by no means revolutionary, and the same principles were being adopted abroad,, but with some variation of detail. They could be adopted as the basis on which tenders might be obtained, and so ensure that these shall be prepared on equal terms; and it was hoped that they would be of considerable service in placing building construction of this type upon a recognised footing, and serve to explode the idea that there was anything of an occult nature connected with the necessary calculations. For some fifty years past, viz., from the date of Wilkinson's patent in 1854, the attention of many men had been directed to improving the theory and adding to the practice of building in concrete reinforced in various ways, and it could not be said that the present state of knowledge was due to the efforts of any one man. Special skill was, of course, needed, owing to the limited practice; but in the preparation of the report a preference for any feature which was claimed as patent had been avoided. Therefore special forms of bar or peculiar arrangements were not referred to, and they had confined themselves to the laying down of principles for all kinds of structures reinforced with ordinary bars. The report itself, although short, was the result of many lengthy discussions and investigations. It was not claimed to be final, but simply a reasonable guide in the present state of knowledge. In conclusion, Sir Henry moved the adoption of the report, and that copies with explanatory letters be sent to the Local Government Board and the London County Council.

Mr. J. Slater, in seconding the motion, said that they, as architects, were bound to be highly interested in any new invention which dealt with methods of construction, and it was extremely desirable that any such inventions should be submitted to the deliberation of a perfectly independent and unbiased body of men. It was desirable, not only in the interests of architects, but also in the interests of their clients, and particularly in the interests of the inventors themselves. Naturally, they were somewhat shy of recommending to their clients anything that was of an empirical nature, because, of course, they could not risk a failure. Their clients, under ordinary circumstances, were adverse to making experiments of their own on the ground of expense, and therefore they were inclined to fight shy of new experiments, but it might very well be that by this disinclination to run any risk they might lose a great deal if the new invention was such as would admirably suit their requirements. But especially was such investigation desirable in the interests of inventors themselves. Inventors, as one very well knew, were inclined to be both a jealous and sanguine class of person. Many of them knew the old story of the stage-carpenter who invented a method of producing thunder on the stage which was extremely naturalistic. One day he heard that at a rival establishment they were creating very realistic thunder-storms, and so he went to the rival theatre, and when he heard the noise he jumped up and called out, "That is my thunder!" He was inclined to think that many inventors, when others invented or discovered something which had a close similarity to their own bantling, were inclined to cry out that it was their thunder. Inventors were also, as a rule, a sanguine class of persons; theirs had been the brain from which had emanated the new idea; theirs had been the trouble of investigating, of experimenting, and of bringing down from the heights of theory to the solid domain of hard fact and practicability and usefulness the thing they had discovered; and no one could make complaint at their being sanguine, for it was only human nature. But there was a real danger that the people who had invented a new thing could not control the well-nigh uncontrollable tendency to magnify the good points of their invention, and to minimise those slight symptoms which might tend to show defects, because they were so certain they were right. He felt confident that the publication of the report of the Committee would do a great deal to encourage and to advance this novel mode of building in ferro-concrete. Sir Henry Tanner had said that the report had been in their hands for some time, but he had only been able to go cursorily through it. A great deal of it was of a very abstruse nature, and the calculations and many of those sort of things were matters which many of them would be unable to go into for themselves, but they could, at any rate, endorse the recommendation of the Committee that the existing by-laws, whether of the London County Council or of any local bodies, ought undoubtedly to be so modified as to allow the use of this new material as extensively as possible. From all that he, and he believed most people there, had seen of the new invention, they could thoroughly agree as to what had been said of the necessity of extremely careful supervision in the manipulation of the material. There was a quotation in the last number of the *Journal* from a paper by Col. Winn, in which he said that, with all their care to secure what they desired, yet a careless man with a shovel might do an enormous amount of damage, and it was very desirable indeed that in this new method of construction the greatest possible care should be taken. While seconding the adoption of the report, he would also like to propose a hearty vote of thanks to the Committee for the investigations they had made and the trouble they had taken.

Mr. E. F. Etchells, in supporting the vote of thanks, said that he knew full well that not one-fiftieth of the work the Committee had done was visible, and he congratulated the Royal Institute of British Architects upon being the pioneers in the matter of reinforced concrete amongst the learned societies and institutions of this country. The paper would be exceedingly useful, and one of its chief advantages was that it would admit all patents on an equal footing. He would say, "Let each patent be tried except patent ways of calculation," and the report of the Committee would prevent that. He was delighted to see that the Committee had made such a consistent effort to get trained and scientific methods of calculation, and where in the present state of the subject that had not been possible they had gone as near the ideal as they could. He also congratulated them on the care with which the general provisions had been laid down. For instance, they said:—"If the metal skeleton is properly coated with cement, and the concrete is solid and free from voids, there is no reason to fear decay of the reinforcement in concrete of stone, gravel, cinder, coke breeze, etc." This was exceedingly necessary, for the Committee of the Structural Association of San Francisco recommended that the use of cinder concrete should be forbidden. In the practical carrying out of the work there were thousands of bends and ends, and he would like to ask the Committee to add one more paragraph to the report giving the benefit of their experience, and showing how this coating may be everywhere and efficiently done. There was, however, a greater objection to the use of coke breeze than its cracks, and Messrs. Marsh & Dunn in their book said that the resistance of coke breeze to compression might be taken as one-third that of broken stone, and it might be even less. At the end of the clauses dealing with materials there was no definition of "accidental load," although there was a note on the following page of the report. Even that was not very clear, and the words "superimposed load" might be better than those used. In the section of the report dealing with methods of calculation, in paragraph 3, they were told how to estimate the loads at different levels. What was intended was to make the usual provision for the fact that, in an ordinary building, all the floors would not be loaded to their fullest capacity at the same time. Incidentally, he noticed that the Institute now proposed to reduce the loads by tens per cent., whereas in the case of their recommendation as to steel-frame buildings they only reduced it by fives per cent., so that they had two sets of figures. It might be that there were different Committees considering the two matters, which would account for the differences in the suggestions, but, still, there was only one Royal Institute of British Architects, and only one word should go to the outer world. If they had learned better now, then there should be other reservations made. In the case of a warehouse building it might be that, owing to advancing or lowering of prices, the merchant might hold goods back, and it seemed quite possible to him that the floors might be loaded to their fullest capacity, and therefore some reservations should be made there. It might be said that the rule applied to hotels and public buildings, and so on, but not to warehouses. Moreover, the difference between the two ratios—one dropping by tens per cent., and the other by fives—gave a difference of 13·6 per cent. in favour of reinforced concrete, so that, while steel construction was fighting for its own, they had given reinforced concrete a start, whereas they both ought to be put on the same terms. He would like to know where the tens per cent. reduction was from. Mr. Etchells proceeded to criticise at some length the formulæ and diagrams in the report, and demonstrated alleged inaccuracies by blackboard calculations.

The Secretary asked that the speaker should communicate his criticisms of the formulæ in writing, as it was impossible for the shorthand writer adequately to deal with them.

Mr. H. D. Searles-Wood said that Professor Unwin had better answer the criticisms on the formulæ in writing, as he was responsible for them. Mr. Wells, who had promised to be present, was unfortunately unable to come, but would communicate the result of some investigations he was making.

Mr. W. Dunn said that, with regard to the observations of Mr. Etchells on cinder concrete and the report of the Structural Committee of San Francisco, if his memory served him right, the San Francisco Committee appointed a sub-committee of two to investigate the subject, and that sub-committee found that where rust existed it was because the concrete was exceedingly porous. The sub-committee did not controvert the conclusion arrived at by the exhaustive experiments of Professor Norton made at the Fire Insurance Station at Boston in 1902-3. Exhaustive experiments were made there, exposing the iron imbedded in concrete to all kinds of influences—influences which in three

weeks ate through ordinary bars of iron—and he came to the conclusion that cinder concrete was nearly as efficient as stone in protecting iron against rust. He found that the sulphur in it did not affect the iron, because it was neutralised by the lime in the cement. The main factor was, as the Committee pointed out, that the iron should be thoroughly coated with cement-mortar, and next that the concrete itself should be free from voids, which was best managed by making the concrete fairly wet. The Sub-Committee on Materials had the subject before them very much, and pretty well exhausted the subject, and they came to the conclusion to make the recommendation with a full knowledge of the facts as they were known at the present day. As to the question of the reduction of loads, it would be seen that there was no reduction made except for buildings containing more than three floors. He did not remember to have seen four floors fully loaded, and, in fact, it was almost impossible to do so. They had had before them the French Government rules, the Prussian rules, the Swiss rules, the German Engineers' Association rules, and various other rules, and they had to consider all these things, and to make the regulations, and he thought that the recommendation they had made as to the reduction of loads was a reasonable one. As to the matter of mathematics which Mr. Etchells had touched upon, one could not express an opinion without full consideration, but he had no doubt that if they were put before the Committee they would be properly considered.

Major E. M. Paul, R.E., said he was present as the representative of the War Office, although he had hoped that Col. Mayne would have been present to represent that Department. As an outsider, he hoped he might be allowed to congratulate the Institute on bringing the matter so prominently before the public, and being the first in the field to do so. The War Department would undoubtedly utilise reinforced concrete in the future, and no doubt there was a great field for military engineers in applying it for fortification work. How far it could be thus applied they were not at present able to say; but, without doubt, experiments would be made in conjunction with the Royal Artillery, who alone could give them the requisite information as to the effect of projectiles against reinforced structures. He thought he was right in saying that a great deal of reinforced concrete was likely to be used in the rebuilding of Kingston after the ravages of the earthquake, and he felt assured that both the military and civil engineers engaged in rebuilding that town would be grateful to the Institute for having presented that report, which he thought was a very simple one, and yet brought the matter so scientifically before them. There was no doubt but that anyone having the report in their hands could confidently strike out into the designing of reinforced structures without having recourse to any particular patent system. This indicated a very great advance, and one which, he thought, would be of the very greatest benefit to every architect and engineer.

Mr. Matt Garbutt said he would like to call attention to one point which had not been referred to. Architects had to deal with buildings erected in most cases in big cities on leased land, and clients expected that the buildings erected should last for the term of the lease—say, eighty or ninety years. Of course, it would be unreasonable to ask at that moment for the result of eighty or ninety years' experience of this material, but from what one had seen of the rusting of metal embedded in concrete he felt convinced that occasionally it would take place, and he presumed that those dealing with this material would be inclined to take into account the possibility of such a thing happening. He took it from the practice of those who were going in for this sort of thing that they did consider this would occasionally happen. They knew that when a very small film of rust formed on a bar of iron it would burst the concrete even if it got a greater covering than 1 in. or 2 in. He found that in the report the figure was given for the adhesion of concrete to metal as 100 lb. per square inch. If any such thing as he had suggested took place, that figure of 100 became 0, however small a film of rust was formed. He was not at all convinced that they were going to get concrete anything like waterproof in a general sense. So far as his experience went, and he admitted it was limited, of iron or steel embedded in Portland cement and sand it showed that moisture got through, and that the metal did rust. To what extent it acted he had not sufficient data to say, but he had seen the metal very much rusted, and the cement split up to an extent which would be fatal to ferro-concrete construction. He was of opinion that it should be pointed out in the report that this adhesion of concrete to metal was not a thing to be relied upon. Everyone knew the effort of every patentee now was to invent a bar which would have some sort of shoulder upon it to give a mechanical grip between the concrete and the metal, and they did not rely on adhesion, and he thought it rather a pity that the Institute, without some careful note of warning, should put forward this figure as a basis of calculation.

Mr. C. F. Marsh said that with regard to what the last speaker had said as to the rusting of metal in concrete they had had a great many facts found out by several persons in the past, and he thought it had certainly been found that the metal did not rust when protected by concrete. Especially was this so when they coated the reinforcement with grout. Certainly, in any case in which they used large bars it was advisable to coat the reinforcement with grout. It was a very simple matter. They simply took the ordinary grout and put it on with a white-wash brush, and waited until it was dry, and then embedded the bars in the ordinary way. The last speaker said that water would penetrate concrete, and therefore the metal would rust; but if water did penetrate to a slight extent it would not cause the metal to rust if the metal was already protected. As to the effect of adhesion, Mr. Matt Garbutt said the tendency of the present age was to produce a deformed bar which would prevent any slipping of the concrete. It certainly was more or less a tendency in America, and that he thought was a great deal due to the fact that everyone wanted to make a fresh patent, and therefore they designed a deformed bar. It had been pretty well shown by all the experiments they had that a plain iron bar would resist sliding through the concrete under the ordinary stress put upon it, provided, of course, that it was split at the ends, which was always the case. One speaker referred to the care necessary in constructing reinforced concrete, and there was not the slightest doubt that this was needed; but that case was just as necessary in steel construction. Only ordinary care was required in reinforced concrete, but the special thing which was wanted was good supervision. The ordinary workman, as they all knew, was extremely apt to shirk his work and do it in as slovenly a manner as he could, but with careful supervision and a little choice of workmen it was perfectly easy to construct reinforced concrete which, if properly designed, would resist any stresses which would come upon it in the ordinary way. In regard to the adhesion of concrete to metal being reduced to naught, a slight rust, provided that any loose rust was brushed off, was rather better for adhesion than plain bars without rust.

Mr. Matt Garbutt said a point occurred to him in listening to the last speaker. This adhesion of concrete to metal seemed to be somewhat on the footing of another adhesion which existed in structures, but which, in this country, was not taken account of in considering their strength. In riveting there was a considerable surface adhesion, but it was not the practice of English engineers to take it into account. He was pleased that Mr. Marsh referred to the turning-up of the end of the bar, and he would like to suggest that they should put a note in the report that the ends of the bar should be split and turned up or down.

Mr. Etchells said that there was already a note to that effect in the report.

Mr. Marsh said that Mr. Matt Garbutt had pointed out that the adhesion was always excluded by English engineers in riveted structures. Of course, the fact that moisture could get between the two surfaces of the iron would tend to do away with the adhesion, and therefore it was very natural they should not rely on the adhesion of steel riveting.

Mr. E. T. Hall asked if the Committee had taken into consideration the danger which might arise in the case of a fire where the ferro-concrete stanchions might be subjected to being played upon by water. Would that not cause a splitting of the concrete and a collapse of the building? He had known of some very grave collapses where rust had got on to the metal in ferro-concrete. An engineer told him some time ago of some large reservoirs erected in Spain where the water got through fissures in the concrete and attacked the metal, which rusted very badly, and the reservoirs leaked very much. One of the gravest things in the use of reinforced concrete appeared to be the personal equation. If they could be sure that every man did every little piece of work thoroughly well they were safe, but if one man was careless he might ruin the structure. He had seen ferro-concrete used, and it was very common for the bars not to be painted with cement. One always put it in the specification, but he had again and again seen it neglected. If they could ensure that the metal was always covered with cement, they were safe, but, as one of the speakers said, supervision was of great importance, and careful workmen still more important.

Mr. J. J. Burnet said he thought the discussion showed how very varied the opinions were upon the matter, and he rose to ask how far they were going with this report. He was deeply sensible of the obligation they were under to the Committee for their labour, but he would be exceedingly nervous if there was the least chance that the report would be taken as a text-book issued by the Royal Institute of British Architects.

Mr. Dunn said that, with regard to fires and stanchions, there was no doubt that a stream of water at close quarters would batter down a thick wall, but no fireman would direct water at a structural support. As to what Mr. Burnet had said, the idea was that the report should be used. The great majority of the members of the Institute might have to use reinforced concrete, and so far they had had to rely on patentees. They wanted something which was authoritative, and on which they could say, "If you make me an estimate, base it on these rules." If they did not adopt the report the labours of the Committee would have been rendered in vain. It was a thing which really they did want. Public bodies and private individuals required it, and the names of those who had served on the Committee was a guarantee.

Mr. Burnet said he was sorry if his remarks conveyed the impression that he cast any doubts on the value of the report, but they were architects and designers, and they had to lay the responsibility for each material on the specialist of the particular method. He did not think they were entitled to be authors of a text-book, or, as a body, take the responsibility which should be incurred by individuals.

Sir H. Tanner, having thanked the meeting for the vote of thanks, said that those who had studied reinforced concrete had great faith in it for the future. He had constructed three works, one of which was rather a large one, and he had some faith in it. As to economy, there was no doubt about it. Mr. Hall mentioned some reservoirs in Spain, but he did not think that what happened in Spain need be regarded as of any moment whatever.

Mr. Hall: It was an English engineer.

Sir H. Tanner said he was in Madrid the day after an accident had happened to some reservoirs by which about thirty people were killed, and he saw the whole thing was badly done and was altogether too slight for the purpose. Mr. Burnet looked upon this question from a different point of view altogether. He admitted that there was not much art about ferro-concrete, but it was really a practical matter, and they could not get much beauty out of it. At the same time, it was incumbent on them to make use of it if they wanted to economise. They could use other things for all the visible parts where they wanted to improve the appearance, but it was no good burking the question of using it, for it would have to be used. If an architect did get a specialist to devise a building for him, he could not get away from the responsibility. He had employed a specialist in two cases, but he had taken care to see, as far as he could, that everything went satisfactorily, and he did not think

his Department would be altogether satisfied with him if anything went wrong with those buildings.

The Chairman, in submitting the resolution for the adoption of the report, said that the criticisms which had been made would, of course, be duly considered by the Committee. He did not agree with Mr. Burnet that this ought not to be put forward by the Institute. When they were looking at a stone building it did not matter whether the stone was, more or less, a veneer. It did not much matter whether it was backed up with brickwork or ferro-concrete. They must have a backing of something, and if ferro-concrete was cheaper and more substantial, he did not see why it should not be adopted by architects. One might imagine it was going to make a revolution in architecture, but he did not think it would make such a revolution as the steamboats did with shipping. If it did, let them hope that the architects of the future would be able to make the architecture equal to the naval architecture of the battleship now.

The report was then adopted.

The Chairman announced that a business meeting would be held on Monday, June 10, when the result of the elections to the Council and the standing committees would be announced and other business transacted.

Archæological Societies.

DURHAM AND NORTHUMBERLAND ARCHITECTURAL AND ARCHÆOLOGICAL SOCIETY.—The first country meeting of the year of the Architectural and Archæological Society of Durham and Northumberland, took place on the 24th ult. at Prudhoe. During the day Prudhoe Castle, the Grange at High Prudhoe, Ovingham Church, Bywell Castle, and the contiguous churches of Bywell St. Andrew and Bywell St. Peter were visited, short descriptions of each being given by Mr. W. H. Knowles, F.S.A., of Newcastle. Prudhoe Castle is romantically situated on an isolated mound about 500 yards from the river Tyne, and occupies what would in the mediæval days be considered an ideal site for strength and invulnerability. The castle is the property of his Grace the Duke of Northumberland, and the modern dwelling within it is now occupied by Mr. T. D. Milburne. The castle was approached by the barbican and inner gateway between which was the drawbridge over the moat before the latter was filled up. This gateway, as Mr. Knowles explained, is the earliest part of the castle, and is Norman. The chapel above the old gatehouse is about a century later, probably of Edward I.'s time. It has a beautiful little oriel bay forming the chancel, lighted by two lancets, and forms a very choice little bit of Early English domestic work. The party then passed through the outer bailey and in the wall examined the entrance of what is supposed to be a subterranean passage leading down to the river. The great tower or keep, partially dilapidated, was inspected. It is about the same date as the keep at Newcastle, which was built between 1170 and 1180. Leaving the castle by way of the picturesque gardens the party climbed the hill to Prudhoe to see the Grange, now a modernised residence, but which contains a doorway with Early English mouldings and walls of great thickness, probably forming part of the chantry chapel of St. Thomas the Martyr. The doorway is a very interesting specimen, and was generally voted to be well worth the climb up the steep bank to view it. Returning, the company crossed the river and inspected Ovingham Church. Mr. Knowles said that perhaps the most interesting feature of the church was the tower at the west end. It was similar in some respects to those at Bywell St. Andrew's, Warden-on-the-Tyne, and Billingham, in Durham county; and there were similar towers in Lincolnshire. The characteristics of them was that they were built without any projections or buttresses, without any offsets almost. They were XIth century, and just a little pre-Conquest. Although some people might call them Saxon, they were unlike the earlier Saxon work done by Wilfrid and St. Bede at Hexham, Jarrow, and Monkwearmouth. They were a type by themselves, and no doubt just built in the time of Edward the Confessor. The tower might have been built for defence as much as for any other purpose, and was divided into four or five stages. The belfry stage at the top was somewhat elaborate, with its double-lighted window. The tower belonged to a church of which probably there were no remains excepting the west end of the nave, evidenced by the straight lines which indicated a nave without aisles. The church, such as at first existed with its western tower and nave, gave place to considerable addition when the chancel and transepts were built. These followed, no doubt, soon after the energetic church-building period of Bishop Pudsey of Durham, and was altogether a very simple and effective structure of probably the first quarter of the XIIIth century. The peculiarities are the exceedingly long transepts, the plan being somewhat after the form of a Greek cross. The aisles are on the west, and not on the east side of the transepts. The general peculiarity of early churches was their height in comparison with their width, and that accounted for the loftiness of that church. The low side window, the piscina, and other antique objects having engaged attention, the party visited the tomb of John Bewick, the engraver, and afterwards took train to Stocksfield. A walk of three-quarters of a mile brought the company to Bywell Castle. At Bywell, as at Dunstanborough, Bothal, and Tynemouth, the gatehouse was the keep, and there they got the entrance into the castle proper. Bywell is first mentioned in connexion with Guy of Baliol, on of the followers of the Conqueror, and in Edward I.'s reign it was occupied by one of the Nevilles. The machicolations above the gateway from which to throw molten substances upon an attacking foe claimed attention, as did the aperture over the straight stairway leading to the first floor, used for a similar purpose. The place is full of nice architectural detail in the way of window embrasures and fireplaces and turrets, and the grooves for the portcullis, together with the original iron grill at the foot of the staircase and the oaken gate at the entrance, all attracted the attention of the visitors. The date of the present building is XVth century. The church of St. Andrew was then inspected, Mr. Knowles stating that it was another of the early pre-Conquest churches similar to those at Warden, Billingham, and Lincoln, and was the smallest of the lot. The wall on the east side of the tower denotes the width and position of the nave that was contemporary with it. One reason why it was supposed to be merely pre-Conquest and not of the early part of the Saxon period was the fact that early stones similar to those of Saxon crosses were built into the tower. With regard to the church of St. Peter being so close to that one he considered the story of the two sisters who quarrelled, which was given as the reason, to be all fudge. Though its population has now disappeared, Bywell was once a thriving place, the populace being makers of armour and iron workers. They could still see the old market cross, which stood originally between the two churches. The church of St. Peter, the earliest portion of which is XIIIth century, was then viewed, and some very pretty interior architecture, especially in the way of windows, were inspected, this concluding the day's programme.—*Newcastle Journal.*

Architectural Societies.

ARCHITECTURAL ASSOCIATION OF IRELAND.—The concluding general meeting of the present session of this Society was held recently at the rooms of the Association, 15, South Frederick-lane, Dublin, the President, Mr. J. Holloway, in the chair. The Hon. Secretary read the result of the ballot for offices for the ensuing session, viz. :—President, Mr. R. M. Butler, F.R.I.B.A.; Vice-Presidents, Mr. Edwin Bradbury, M.R.I.A.I., and Mr. Lucius O'Callaghan, M.R.I.A.I.; Committee, Messrs. J. H. Webb, Harry Allberry, A.R.I.B.A., N. G. Leask, P. L. Dickinson, G. F. Beckett, F. G. Hicks, F.R.I.B.A., A. G. C. Millar, J. Holloway, and J. A. Geoghegan; Hon. Treasurer, Mr. F. Hayes; Hon. Secretaries, Mr. R. Donnelly and Mr. C. H. Mitchell; Hon. Librarian and Registrar, Mr. G. G. Lynes; Hon. Auditors, Mr. C. L. Harrison and Mr. L. du P. Millar. The reports of the Class of Design and visits to buildings were next read. The prize-winners were announced as follows :—The Architectural Association Travelling Studentship, Mr. P. J. Munden; the Royal Institute Prize for a design for a country hotel, won by Mr. C. G. Ramsay; the President's Prize, Mr. P. J. Munden; the Downes' Bronze Medal for sketches, Mr. H. T. O'Rourke; the Vice-President's Prize, Mr. C. Keefe; the Class of Design, Mr. P. J. Munden. An announcement as to the annual excursion, to be held in England from July 9 to 13, was made by Mr. E. Bradbury. The President then read his valedictory address, in which he dealt briefly on the year's progress and the recognition which the Association now receives amongst kindred English and Irish societies, and with the necessity for architects to depend more upon proportion and simplicity when dealing with native stone, instead of upon the ornamental carving more suitable for other materials and a less destructive atmosphere. He also referred to the new painting craze, which threatens to hide Dublin's limestone fronts under a glaring coat of inharmonious colours; of this the International Exhibition may be the cause. Touching briefly on Mr. Norman Shaw's victory over the mercantile spirit with regard to the new quadrant at Regent-street, the President concluded his address by referring to the successful exhibitions held by the Association during the year, which were visited by many of the public. The President-elect was moved to the second chair. A vote of thanks to the President was proposed by Mr. Allberry, and seconded by Mr. F. Shaw, and was carried by acclamation A vote of thanks to the Class Secretaries was proposed by Mr. F. Shaw, and seconded by Mr. J. W. Beckett, and carried. Mr. A. E. Bradbury proposed a vote of thanks to the Hon. Secretaries and the Hon. Treasurer, which was seconded by Mr. A. G. C. Millar, and carried unanimously.

ANCIENT IRISH MONUMENTS.

IN Wednesday's Parliamentary Papers Sir Thomas Esmonde asks the Chief Secretary for Ireland for the names of ancient monuments situated on estates being sold under the Act of 1903, communicated by the Estates Commissioners to the Board of Works.

Mr. Birrell replies that the Estates Commission had communicated particulars of the following fifty-two ancient monuments which they considered might be worthy of preservation :—Carbery Church, Carbery Castle, County Kildare; Lismateige Castle, County Kilkenny; Ola Castle, County Limerick; Sinners Stone, County Cork; Bremore Castle, County Dublin; Leac-an-scail, Augustinian Friary, County Kilkenny; Ballycowan Castle, Srah Castle, King's County; Heathstown Castle, Cranoge, County Westmeath; Tomdeely Castle, Tomdeely Church, County Limerick; Mahee Castle, Mahee Round Tower, Mahee Church, County Down; Templeaveigh Church, Ballyboggan Abbey, County Meath; Mulrankin Castle, Rathronan Castle, County Wexford; Neigham Castle, County Kilkenny; Wonderful Barn, County Kildare; ? Castle, ? Castle, County Westmeath; Giant's Grave, Puck's Castle, Shankhill Castle, County Dublin; Cromlechs, County Dublin; Carrig Castle, County Tipperary; Kells Abbey, County Kilkenny; Mylerstown Castle, County Kildare; Gortnaclea Castle, Clonburren Castle, Colbally Church and Raths, Chair of Kyle, Queen's County; Cornaveigh Castle, County Cork; Troy Castle, County Limerick; Moymet Castle, County Meath; Dungall Fort, Drumfane Moate, M'Quillan's Castle, County Antrim; Caherbewly Rath, County Tipperary; Round Tower, County Down; Seahorse Memorial, County Waterford; Cragg Castle, County Tipperary; Giant's Graves, County Tyrone; Kilconnell Castle, County Tipperary; Newcastle Castle, County Limerick; Ballycatteen Rath, Downmacpatrick Castle, County Cork; Giant's Grave, County Donegal.

Illustrations.

MAIN STAIRCASE, NEW WAR OFFICE.

THE main staircase at the War Office is one of the chief internal features of the building. It is approached from the principal entrance in Whitehall. The stairs start with a wide central flight turning to the right and left, and eventually landing immediately above the start, the last flights being carried on an arched bridge spanning the whole width of the well-hole. The walls are of Painswick stone with plain broad surfaces from ground to first floor, the steps of Piastraccia marble with alabaster balusters and breccia capping.

At the first floor level an arcade runs round the well-hole with pilasters in Painswick stone and alabaster imposts to arches. The two columns at the foot of the staircase are of breccia. It is lighted from a large central dome; and at night by electric light concealed behind cornice. The marble work was executed by Messrs. Farmer & Brindley, of Westminster, and the plaster dome and ceiling by Mr. James Annan, of Pimlico.

The late Mr. William Young was the architect, and the building has been carried out under the supervision of Mr. Clyde Young, in conjunction with Sir John Taylor, representing the Office of Works.

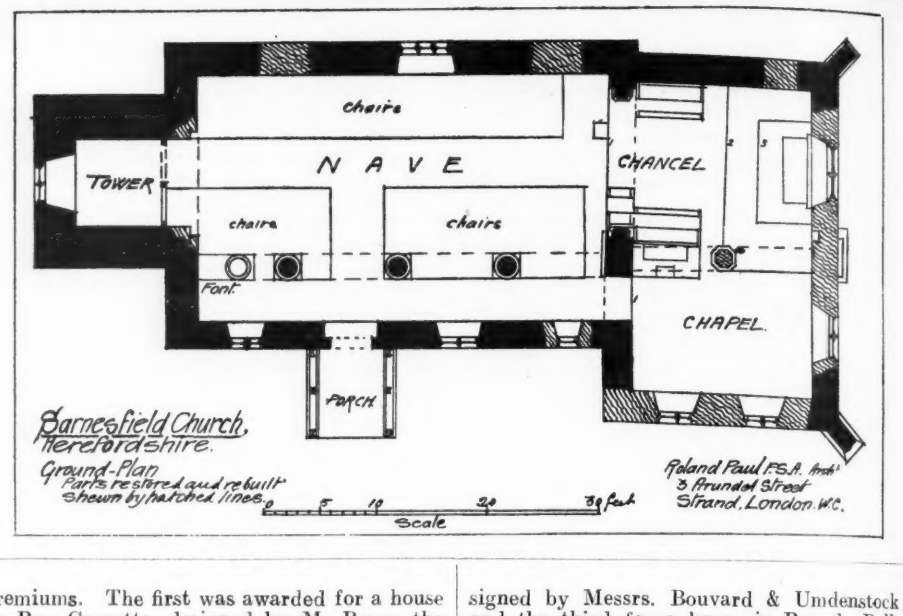
The drawing is exhibited at the Royal Academy.

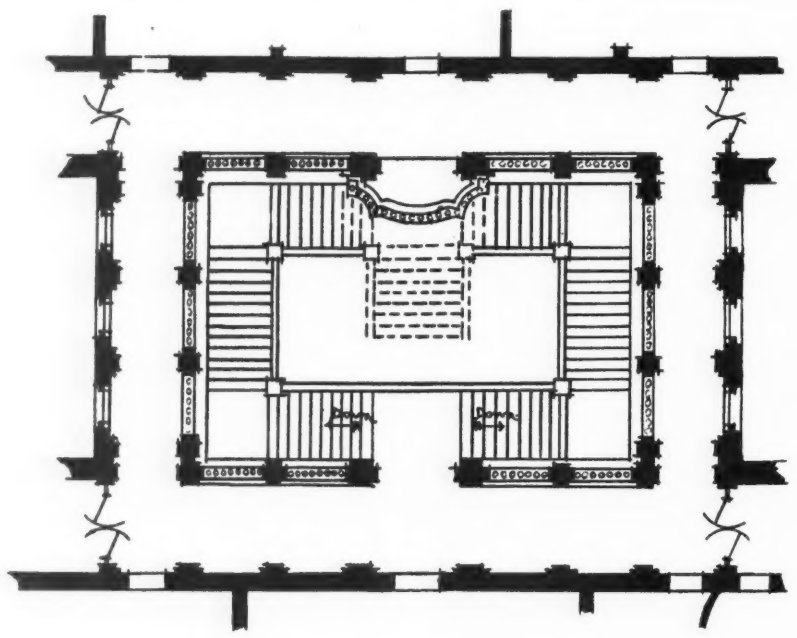
PARIS NEW FAÇADES COMPETITION.

As our readers may remember, there has been for some years past a practice established of offering premiums to the architects of what are adjudged to be the best street fronts finished in Paris during the year; a method of endeavouring to keep up a high standard in the street architecture which we should be very glad to see imitated in London.

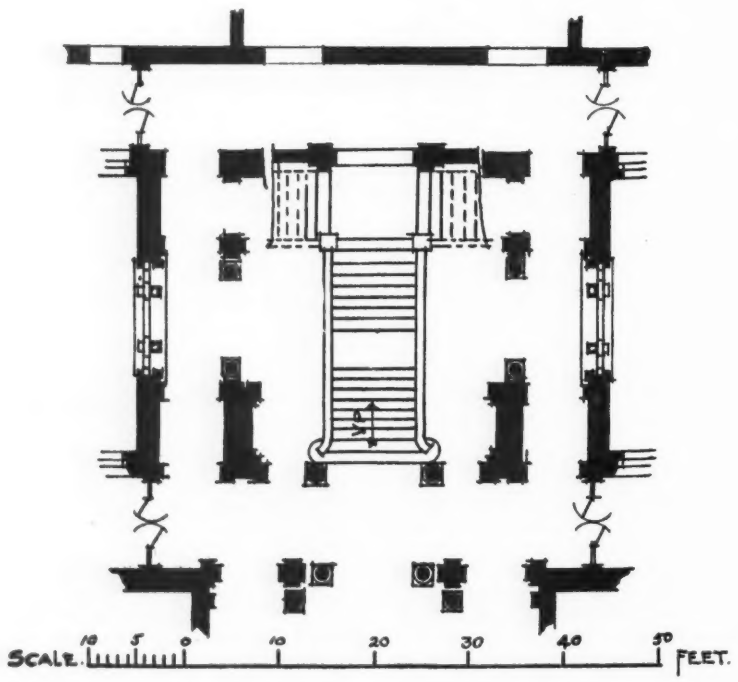
We give in this issue photographs of the houses which have received the three first premiums. The first was awarded for a house in Rue Corvette, designed by M. Benz; the second for a house in Avenue Alphand, designed by Messrs. Bouvard & Umdenstock; and the third for a house in Rue de Bellechasse, designed by M. Le Tourneau.

Two or three years ago there seemed to be a tendency to award these premiums rather for novelty than for excellence in the traditional Paris forms of street architecture, and one or two very unhappy specimens of *art nouveau* were thus distinguished. We are glad to see that this tendency seems to have subsided, and the façades premiated this year are all of a sober and dignified architectural character.





PLAN AT PRINCIPAL FLOOR



PLAN AT GROUND FLOOR

Main Staircase, New War Office.

SARNESFIELD CHURCH, HEREFORDSHIRE.

The interesting little church of Sarnesfield, about two miles from Weobley, was reopened on May 16, after restoration.

In 1870 parts of the chancel and chapel walls were rebuilt and new windows inserted, and also in the nave, quite out of harmony with the old work. The floors were raised, destroying the good proportions of the interior, and the roofs were covered with Broseley tiles.

The work now done has included the total removal of all the work done in 1870, which had already shown considerable signs of decay. The lath and plaster has been removed from the roofs and they have been boarded throughout in oak; the tie-beams, where cut away, have been replaced, the Broseley tiles removed, and stone slates substituted. The floors have been taken up and relaid at the old levels, all inscribed stones being replaced in their old positions. New windows have been inserted in the chancel and chapel, and one in the nave-aisle, and an arcade of two bays separating the chancel and chapel. The altar-table, choir-seats, and lectern are all of English oak, and chairs have been placed in the nave in the place of the former pews. The windows have been reglazed throughout, the few fragments of old glass having been inserted in the east window of the chapel.

The general contractors were Messrs. Collins & Godfrey, of Tewkesbury. Messrs. H. H. Martyn & Co., of Cheltenham, executed the fittings from the architect's designs; and the windows have been reglazed by Mr. Gamon, of London.

The architect was Mr Roland Paul, of London. The drawings are exhibited in the Royal Academy.

West of the porch, and shown in the view of the exterior, is the tomb of John Abel, the celebrated Herefordshire builder of the XVIIth century.

NEW CHURCH, FOCHRIW.—The foundation-stone was recently laid of a new church which is in course of erection at Fochriw. The church, which is dedicated to St. Mary the Virgin, is being constructed on a site midway between Fochriw and Pentwyn by Messrs. W. Williams & Son, New Tredegar, at a cost of over 1,600*l.*, to plans drawn by Mr. E. Douglas Hoyland, London. The main floor will, when completed, accommodate 300 persons. In addition, there is to be a baptistery, choir chancel, transept, and sacristy on the same floor. In the basement will be a hall to accommodate 300 persons. The interior is to be lined with terra-cotta and small courses, with the dressings to the windows and doors also in terra-cotta.

Builders' and Contractors' Column.

Departmental Committee on Industrial Diseases.

It will be remembered that the Workmen's Compensation Act, 1906, which comes into force on July 1 next, only applies to a limited number of what are known as industrial diseases. These we fully treated of in an article in these pages April 6 last. But the Act in sect. 8, subsects. 6 and 8, contains provisions for extending the Act to further diseases by Provisional Orders confirmed by Parliament, and the matter was referred to a Departmental Committee to report what further diseases can properly be added to those mentioned in the Act as due to industrial occupations and distinguished from injuries by accident which are brought within the Act by sect. 8, subsect. 10.

This Committee has now issued a report, which contains some interesting information, and also foreshadows a considerable extension of the Act by the inclusion of further diseases.

In making this inquiry the Committee has had to consider (1) whether the disease is already within the Act as being specifically mentioned, or as coming within its scope as an "accident"; (2) whether it incapacitates for more than a week; and (3) whether it is so specific to the employment that it can be established in individual cases.

It is at once obvious that the above considerations involve points of considerable nicety. For instance, the Courts have already held that anthrax may be the consequence of an "accident" (see Turvey *v.* Brinton, the *Builder*, April 29, 1905), but the Committee appears to have approached the subject in a thoroughly businesslike spirit, and its recommendations are very instructive. In considering the point what diseases are an "accident" under the artificial interpretation placed upon the Act of 1897, for instance, the Committee has drawn the line on the principle that diseases which are "accidents" must be due to a cause which operates at a definite moment of time as distinguished from those which cannot be attributed to a cause of that character. Again, the Committee seems to have been duly impressed with the necessity of including only such diseases as may reasonably be said to be specific to any employment; and, lastly, the Committee has borne in mind the varying burden of proof contained in the Act, and has prescribed in each case upon whom this burden is to be laid. In the Act, it must be remembered, certain diseases are scheduled. They are anthrax, lead-poisoning, mercury-poisoning, phosphorus-poisoning, arsenic-poisoning, and ankylostomiasis, but the Act has also in the schedule certain processes, and by sect. 8, subsect. 2, it is provided that if the workman was engaged in any process thus scheduled, and the disease contracted is that scheduled opposite to the process, the disease is to be attributed to the process unless the certifying surgeon certifies that it was not due to the nature of the employment, or the employer can prove that it was not so.

The Committee has set out certain diseases which it considers should be added to the schedule in the Act, and certain processes in which if the disease is contracted the burden of proof will be laid upon the employer. Eighteen diseases are thus set out. Arsenic and lead poisoning are extended so far as the scheduled processes are concerned by inserting handling of the same, and an important addition for builders and many other employers is the inclusion of "eczematous ulceration of the skin by dust or caustic or corrosive liquids or ulceration of the mucous membrane of the nose or mouth produced by dust." No process is specified; therefore, the onus of disproof is in this case not laid upon the employed. Chimney-sweeper's cancer is included in the process of chimney-sweeping. It is to be hoped that this will not necessitate householders insuring the chimney-sweep. Probably not, since, as far as the householder is concerned, the sweep is casually employed otherwise than for the purpose of the employer's trade or business. The report contains considerable information, not only in connexion with diseases and illnesses which it recommends should be added to the Act, but also with reference to those excluded, and it should be read by all who are interested in the subject of compensation.

Cinder Concrete in Germany.

Until a few years ago coke-breeze, cinders, clinker, and coal residues generally were used in Germany to a very considerable extent as aggregate for concrete, owing largely to the fact that these materials could be obtained either for nothing or at a purely nominal cost.

As a rule, the material was carefully selected, and only used if on examination it was found to be free from acids. Such examination was carried out by depositing the material in vessels containing clear water, and testing the water on the day following with litmus paper. If blue litmus paper became red, the material was rejected as unfit for use.

This precaution was at first judged to be satisfactory, but was afterwards found inadequate, as practical experience showed that coal residues, even when free from acids, were unsuitable as aggregate for concrete used in weight-carrying floors.

In addition to acids, materials of this kind usually contain sulphur, mineral salts soluble in water, unslaked lime, and other deleterious substances not capable of detection with the required certainty by any tests which are possible in actual building practice.

The impurities in question enter into chemical combination with the constituents of cement, forming substances which attack embedded steel, and at the same time reduce the resistance of the cement to such an extent as to endanger the safety of structures in which it is employed.

Blast-furnace-slag is now regarded in Germany as being no better than coke or ordinary clinker. In the fresh state it appears extremely solid and indestructible, but, after a time, falls into its component parts and practically becomes dust. It may happen that during more than a decade slag will show no signs of deterioration, and thereafter rapidly decompose and crumble away.

The composition and properties of blast-furnace-slag vary to a considerable extent. Some varieties contain an excessive proportion of sulphur and others very little of that element. Again, samples are often found which are thoroughly vitrified and presumably of stable character, while other samples from the same furnace are obviously unfit for use. These facts point to the conclusions that slag ought not to be used unless the chemical analysis is entirely satisfactory, and unless the bulk of the material delivered is equal to a previously approved sample.

As long ago as the year 1901, the building authorities of Hanover issued the regulation :—

"So-called breeze-concrete, that is to say, concrete made of cement, sand, and coal-residues, shall not be used for the construction of floors which are required to carry any weight."

Other building authorities shortly afterwards followed suit by issuing similar regulations because they appeared necessary in the public interest for the safety of life and property.

Then, on April 14, 1904, the Prussian Ministry of Public Works issued regulations for concrete and steel construction containing the following general order :—

"In the preparation of concrete only sharp sand and river ballast or some other material which experience has shown to be satisfactory, is to be used, and the ballast is to be of the proper size."

The exact interpretation of this order was left to the various local building authorities, by most of whom, and notably by that of Berlin, regulations were issued forbidding the employment of coal-residues as aggregate in concrete-steel and concrete construction.

From the foregoing general order, it will be seen that before the local regulations were issued, the use of fine ashes in making mortar was prohibited, although pending the action of the local authorities cinder, clinker, and slag were still allowed to be used as aggregate. The definite specification of sand for making mortar was certainly wise, if only for the reason that fine ashes contain a greater proportion of acids and mineral salts than larger fragments of cinder.

In a handbook on concrete which is largely used by architects and engineers throughout Germany, the following recommendations are made with regard to the use of coal-residues as aggregate :—

"Coal-residues of any kind whatsoever must be used with the greatest caution, and only then when other material cannot be obtained.

"It should be remembered that no two samples of such material can be judged from the same standpoint so far as concerns their suitability for concrete-making.

"Therefore, they should only be used if it has been proved that there is no risk of ultimate disintegration, and only if absolute assurance can be obtained that deliveries in bulk shall be of the same quality as the sample chosen."

It is significant that these recommendations were published long before the German State and municipal building authorities were aware of the deleterious nature of coal-residues and prohibited their use as aggregates for plain and reinforced concrete floors.

A point that should not be overlooked in connexion with the use of coke in concrete-steel is the risk of the electrolytic action which is established when steel comes into contact with the unburned particles of coal generally contained in aggregate of this kind. The effect of electrolysis is that free water in the fresh concrete, and the water of crystallisation in the concrete that has set, is resolved into its component parts—the oxygen liberated combining with the iron of the embedded steel, and the process of corrosion being encouraged by the admission of air through the pores always existing in coke or cinder-concrete.

Impregnated Foundation Felt.

A material of general utility to architects and engineers as a means of reducing vibration and noise in structures of various kinds is the woollen cloth foundation felt made by Messrs. Mitchells, Ashworth, Stansfield, & Co., of Leeds. This felt is impregnated throughout by a special oil rendering it impervious to moisture, and the surface is treated by a chemical process preventing the penetration of water and increasing the durability of the material. It is manufactured in sheets up to 60 in. by 30 in., in thicknesses from ¼ in. to 1¼ in., and in three grades of hardness. Impregnated felt can be usefully applied in structural steelwork beneath the bases of stanchions, between the heads of columns and the girders which they support, and in similar positions where a yielding and slightly resilient bed is desirable for taking up inequalities liable to cause vibration. It is also a very suitable material for employment in the foundations of steam and gas engines, and beneath the bases of woodworking machines, electric motors, and power transmission appliances.

General.

The St. Pancras Ironwork Company, Ltd., 171, St. Pancras-road, London, N.W., have just received news that they have obtained a Gold Medal for their Patent Steam Wagon exhibited at the New Zealand International Exhibition, Christchurch.

Competitions.

Elementary School, Hadfield, Glossop.—The successful architects in this competition were Messrs. Ogden & Hoy, Strutt-street, Manchester (1st premiated design); Mr. C. H. Willoughby, Parr's Bank-buildings, Manchester (2nd premiated design).

School, Castleford.—The Governors of the Castleford Secondary School considered a few days ago the thirty-eight competitive sets of plans for the new secondary schools at Castleford, which are to cost not more than 12,000*l*. The assessor, Mr. Brierley, of York, gave the first premium to design No. 36, and the second to design No. 20. After consideration of the respective plans, the Governors decided to adopt the design and plans No. 20. The sealed envelopes were then opened, and it was found that the authors of No. 36 design were Messrs. Robinson & Jones, of Leeds, and the author of No. 20 was Mr. W. S. Braithwaite, of Leeds.

Scottish Church Building.—The assessors entrusted with the duty of assessing the plans sent in in the competition for designs for proposed church and manse buildings in

connexion with the United Free Church have issued their awards. The first premium for churches is awarded to Messrs. Greig, Fairbairn, & Macniven, Edinburgh; and the first premium for manses to Messrs. J. W. & J. Laird, Glasgow.

BOOKS RECEIVED.

AIR CURRENTS AND THE LAWS OF VENTILATION. By W. N. Shaw, Sc.D., F.R.S. (Cambridge University Press.)

THE DUTIES AND POWERS OF AN ARBITRATOR. By A. R. Rudall, Barrister-at-Law. (Effingham Wilson.)

THE ART AND CRAFT OF GARDEN-MAKING. By Thomas H. Mawson, Hon. A.R.I.B.A. Third Edition. (London: B. T. Batsford. 30s. net.)

SAND AND CLAY: Their Analysis and Physical Properties. By Augustine C. Passmore. 2s. net. (Manchester and London: The Technical Publishing Company, Ltd.)

Correspondence.

PRE-HISTORIC MONUMENTS.

SIR,—The leading article in your issue of May 18 last is of great importance as touching on so-called pre-historic monuments. The monuments of Sardinia, therein referred to, have doubtless a connexion with those in the neighbourhood of Carnac, Brittany, and the others found in the British Isles at Stonehenge, Avebury, the Channel, Orkney, and Shetland Isles, and may probably be found to include the round towers of Ireland and the one within the grounds of Peel Castle, Isle of Man. I believe, however, a still larger connexion yet remains to be found not only between these ancient European monuments, but also with the so-called pre-historic monuments of Asia, South Africa, and Central America. All monuments are historic, the difficulty is in finding their connexion and sequence with historic monuments, the dates or approximate dates of which are known. It would appear that we are near the point of fixing an approximate period of time to some of the North European Runic monuments, and if that can be done, then the dates of others would follow, and a key may yet be found to the inscriptions. Were this ascertained, how many discoveries as to ancient monuments and ancient history might then be made?

Lübke, the German historian of architecture, wrote in 1855 that, before all things, it was necessary to consider architecture in connexion with the general development of mankind. Since then much progress has been made. Even in what may be called ante-documentary history, we have established the palæolithic, mesolithic, neolithic, and now æneolithic ages, and we know these ages were not themselves contemporaneous throughout the world. The nuraghi of Sardinia appear to myself to be similar monuments to the broches, or so-called Picts' houses, in the Shetland Isles, and were probably erected for purposes of defence, as well as to serve as watch-towers in the respective instances. Both in Sardinia and the Shetland Isles they were erected of unhewn stones without mortar or cement, they taper upwards from the base to a considerable height above the ground—those shown in your illustrations, as also those in the Shetland Isles, have lost their upper portions—and they are also alike in having galleries, small chambers, and stairways in the thicknesses of the walls. The round towers in Ireland, and that at Peel, even though the stones are cemented together, may be of the same age, or not much later. Probably the nuraghi, broches, and round towers were of later date than the tumuli. Tumuli, dolmens, and probably cromlechs and menhirs were erected at the same period, and many tumuli as found in Brittany, Guernsey, and in the Orkney Islands had somewhat of a stone skeleton, or, at any rate, had within them stone chambers serving as tombs; in fact, M. Z. le Rouzig, at Carnac, is of opinion that many dolmens, now incomplete, were sepulchral chambers within tumuli which have been demolished, and the covering of earth removed to manure the surrounding fields in later ages.

It is impossible in the course of a letter to go further into these, but in my opinion it must follow that, because such monuments are spread over such large areas of the world's surface, not only on the same continent, but even on different continents hundreds, yea, thousands, of miles apart, that there must have been far greater intercommunication than we have any idea of, but that a much larger area of the world's surface was known, and probably there was in these earliest ages of which we have any record a degree of civilisation far beyond anything we can imagine.

H. MCLACHLAN.

FIRE TEST OF REINFORCED BRICK FLOOR.

SIR,—In your issue of last week you report upon a "Fire Test of Reinforced Brick Floor." As you do not mention who constructed the floor in question, we should like it to be known that the floor was not ours. We shall ourselves give a public fire test of our patent floors on June 27.

THE "KLEINE" PATENT FIRE-RESISTING FLOORING SYNDICATE, LTD.

The Student's Column.

ELECTRIC LIGHTING AND HEATING.—XXI.

Electric Heating—The Thermal Equivalent of the Electric Unit—The Electric Radiator—The Electric Convector—Electric Cooking—Special Applications.

ELECTRIC HEATING. — It is greatly in the interest of electric supply companies to encourage any load on their stations which will remain constant for a considerable fraction of the twenty-four hours in a day. It has to be remembered that the actual cost of the fuel consumed is only a fraction of the total cost of generating a unit, the "fixed" charges as a rule being much heavier than the "running" charges. For a low generating charge per unit, therefore, it is essential to have the output as large as possible without the necessity of buying more machines. Now, in many cases, electric fires for business premises are only required in the day-time, and they are often switched off before the heavy night load comes on. The supply of electricity in these cases can therefore be done at a very much cheaper rate than the supply for lighting. Even for ordinary houses, the supply for heating is much more desirable than that for lighting, as there is a demand for it during the greater portion of the day. The current, therefore, is often supplied at a reduction of from 30 to 50 per cent. on the cost of that used for lighting.

The advantages of warming rooms by electricity are the ease with which the temperature can be regulated, the absence of dust, dirt, and smoke, the saving of labour, and the economy effected by the much longer time that ceilings, wall-papers, decorations, picture-frames, etc., keep clean as compared with what happens when coal fires are used. On the other hand, as electricians usually recommend that the chimney should be hermetically sealed by cement or brickwork, special care has to be taken to effectively ventilate the room. It is now usually agreed that the quantity of air required per person per hour in a room is about 60 cubic yds., that is, about 120 lb. per hour. Hence, this quantity of vitiated air per person has to be got rid of per hour. When electric heating is used, therefore, special attention has to be paid to the design of an efficient system of ventilation.

The Thermal Equivalent of the Electric Unit.—In Chapter VII. we proved that the Board of Trade unit equals 3,400 British thermal units. In other words, if an electric unit were expended in heating 18·9 lb. of water (1·89 gallons), initially at 32 deg F., it would raise the temperature of the whole of the water to boiling-point (212 deg. F.). The usual charge for a B.O.T. unit is about 2d., and thus, compared with burning coal, it is a costly method of getting heat. If we assume that the calorific value of the heat given off during combustion by 1 lb. of good household coal is 14,000 B.Th.U., then the heat given off by 1 lb. of coal on combustion is 14,000/3,400, that is, about 4 B.O.T. units. The disparity between the costs of heating by coal fires and heating by electricity is, however, not so great as this would at first sight indicate. The most of the heat generated in an open fireplace passes up the chimney with the products of combustion. As the combustion also is seldom, if ever, perfect, more air is extracted from the room than is necessary for the efficient burning of the coal, and this also increases the inefficiency. With electric-heating appliances, on the other hand, practically all the electrical energy consumed can be utilised usefully as heat. We shall now describe the two main types of electric-heating appliances.

The Electric Radiator.—In radiators, a special large type of glow-lamp is employed (Fig. 55). The carbon filament used is so

Fig. 55.

thick that even when it is taking the maximum power (about 300 watts) the filament is only a bright red. The lamps are cylindrical in shape, and frosted.

The general appearance of an electric radiator and the method of connecting it with the mains is illustrated in Fig. 56. WP is the wall plug and S, S, S are the switches for the three lamps. It has to be remembered that the fire-office rules for electric radiators are generally the same as for ordinary stoves, and hence they must be fixed at a safe distance from woodwork and all other combustible substances. All radiators should stand upon suitable fire-proof insulators, and, as a rule, floor sockets are not permissible. Care has to be taken that the flexible conductors are never placed in any position where they may get overheated by the radiators.

In Fig. 56 let us suppose that each of the lamps takes 250 watts. Then each will consume 250/1,000, that is, quarter a unit per hour. If electricity costs 2d. per unit, therefore, the meter bill for each radiator lamp

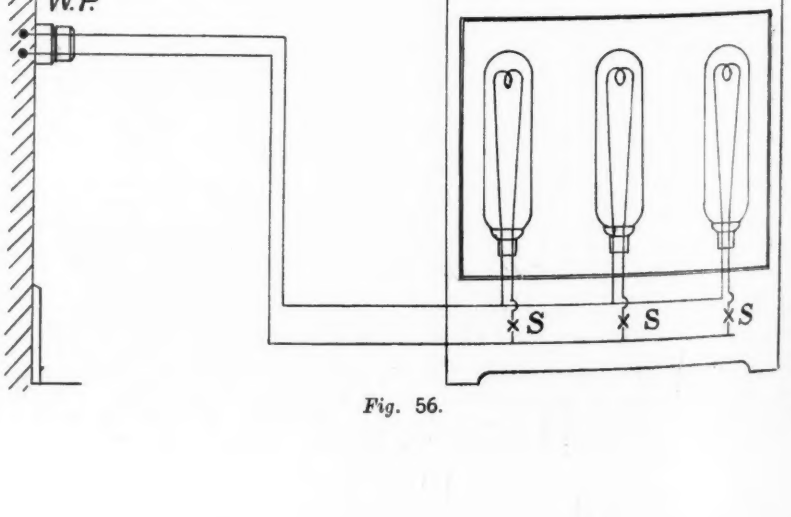


Fig. 56.

will be ½d. per hour. The cost of a radiator lamp is about 4s., but if it be subjected to no mechanical vibrations or shocks, it may last many thousand hours. When the radiator is first switched on in the morning, it is customary to let all three lamps burn for the first hour until the air and the furniture in the room gets heated, and then use only two lamps or one lamp afterwards.

It is to be noticed that with this type of appliance the heating of the room is effected mainly by radiation. The radiant heat coming from the lamps passes through the surrounding air without appreciably heating it until it is stopped by a body which is wholly or partially opaque to heat rays. In the general case it then suffers reflection, absorption, and refraction. If the body be of a dark colour, then practically all the heat rays falling on it are absorbed, the body rapidly getting warmer. The air in contact with the body gets heated by conduction, and so becoming lighter rises, setting up air-convection currents and so preventing the body from getting excessively hot. These convection currents gradually heat up the air in the room.

If a window be too near the radiator lamps the rays from them may heat it excessively, as glass is practically opaque to radiant heat, and hence there is an appreciable loss of heat by conduction across the glass to the outside. A glass fire-screen suitably placed will prevent this loss. Electric radiators are often useful out of doors, for instance, on balconies, as they communicate a pleasant warmth even in the coldest weather to anyone near them.

The Electric Convector.—In electric convectors the currents pass through conductors of low conductivity which thereby get heated and communicate heat to the adjacent air, thus setting up convection currents. The efficiency of an electric convector is therefore mainly due to the current of hot air rising from it. It is sometimes hastily assumed that a radiator, in front of which it is uncomfortable to hold one's hand, must be more efficient that a convector, in front of which the hand only feels comfortably warm. In the latter case, however, the electric power consumed, and consequently the total heat generated, in the room may be much larger.

If the convector have a heavy cast-iron frame, an appreciable quantity of heat may be required to raise it to the working temperature, as the heat taken by the frame has to be supplied by the appliance. A heavy convector, therefore, is only suitable for continuous work over long periods. The heat absorbed by the frame is gradually given to the air in the room after the switch is turned off. For most purposes, however, it is desirable that the appliance should rise to its working temperature as rapidly as possible, and hence convectors with light frames are generally the most suitable.

The Prometheus Company, in their convectors, use a special resistance material to carry the current made up into rectangular strips and suitably supported on metal frames. All the heating elements are enclosed in a brass or copper frame which is made in a great variety of designs. As the heating elements are all arranged in parallel, it is practically impossible for the convector to break down under working conditions. Prolonged tests show that, provided the temperature of the heating elements does not exceed a certain value, they do not deteriorate in use.

The most suitable position for a convector in a room depends on the situation of the windows and doors, on the shape of the room and the position of the furniture. The most economical position for the convectors is the place where the heated air rising from it would have the greatest distance to travel before it came to a window or ventilator. To place it directly under a window or ventilator is inadvisable owing to the large fraction of the heated air that will escape directly without appreciably heating the room.

Sometimes convectors are made with double frames which are placed vertically side by side. If placed horizontally there is very little flow of air between them, and hence the upper one will heat excessively, and the heating elements in it will be damaged. Care must be taken, therefore, never to place them horizontally. They ought never to be placed inside very confined spaces like hot cupboards, linen-cupboards, etc., unless the doors are left open to allow the air to circulate freely through them; otherwise the elements will be damaged by getting overheated.

The Prometheus Company generally fit their convectors with electric lamps in ruby glass bulbs. This makes the appearance of a convector in a sitting-room more cheerful to those accustomed to coal fires without appreciably adding to the cost.

Convectors can be made with metal lugs so that they can be fixed to walls or partitions. As the bodies of the heaters remain comparatively cool, they may be safely fixed to wood partitions. They can be usefully employed for heating public halls and theatres. As a rule, however, they are only used in places where appearance is a secondary consideration. Portable convectors are useful in green-rooms and dressing-rooms, as there is absolutely no danger of fire, and they can be placed in any position.

Electric Cooking.—Electricity is particularly adapted for cooking purposes, as an equable temperature can be maintained with the greatest ease, and there is no smell, smoke, or dirt. With electricity at 2d. per unit the cost is less than with gas at 2s. 6d. per 1,000 cubic ft. For heating water, however, electricity is expensive, although, when only a small quantity is required, it is extensively used owing to its extreme convenience. A pint of water, for instance, can be raised to boiling-point in four minutes by four amperes flowing at a pressure of 240 volts. But as this is practically the fifteenth of a unit, it will be seen that, if the unit costs 2d., the heating of a gallon of water would cost over 1d., and so the cost would be prohibitive if a large quantity of hot water were required.

Special Applications.—Numerous applications are made of electricity for heating tools, etc., in certain special trades. Electric soldering-irons and branders are very clean, and are rapid in action. In bookbinding the small tools used in gilt lettering can be conveniently heated to the proper temperature by being placed on electric hot-plates. The ovens and plates for heating the backs of books can be heated best electrically, for there is less risk of overheating or burning than with gas.

Electric welding is now employed for many purposes. An electric weld can be made more quickly, and is more satisfactory, than one made by the direct application of heat by the smith's method. In the Benardos process of electric welding use is made of the electric arc. An arc is started between the metal to be welded and a carbon rod. The metal is joined with the positive and the carbon rod with the negative terminal of a battery of accumulators. The intense heat developed soon melts a portion of the metal, and a satisfactory weld can be easily made. This method is also used for effecting machinery repairs.

Obituary.

MR. SAUNDERS.—The death, on May 21 (at his residence, Thames Bank Villa, The Mall, Chiswick), is announced of Mr. George Saunders, aged 77 years. Mr. Saunders was elected an Associate in 1856, and in 1869 a Fellow of the Royal Institute of British Architects, and obtained a certificate of competency to act as surveyor under the Acts. Of his recent work in that part of the county we may mention the enlargement of the Upper Latymer School, Hammersmith, by the building of a balance-room and chemical and physical laboratories, etc., and the girls' and infants' schools for the School Board of Chiswick.

METROPOLITAN ASYLUMS BOARD.

AT the fortnightly sitting of the Metropolitan Asylums Board on Saturday last week, the Works Committee reported that as the Managers had decided to withdraw from the Local Government Board the revised scheme for certain proposed alterations and additions to Belmont Asylum, they now recommended: "That, pursuant to clause 5 of the agreement, dated February 26, 1904, between the Managers and Messrs. Thomas Dinwiddy & Sons, architects, the scheme for the adaptation of the remaining buildings at Belmont Asylum for the accommodation of imbeciles, and the employment of the architects in connexion therewith, be abandoned wholly, and that the architects be paid a sum—viz., 878*l.* 2s. 6d., equal to 1¼ per cent. upon the estimated cost (70,250*l.*) of the works." Mr. W. G. Graham proposed as an amendment the omission of the words "and the employment of the architects in connexion therewith," but this found no seconder and the resolution was agreed to.

General Building News.

WESLEYAN CHURCH, ABERTILLERY.—A new Wesleyan church has been erected and opened at Abertillery. The building is designed in the Perpendicular style, and is built of Newbridge stone, with Forest stone dressings. There are galleries all around the interior, with an organ chamber on one side (containing a new organ by Messrs. Hill & Son, London, and costing 500*l.*) in the form of a transept. The roof is an open-timbered one, supported on columns, and lined with matchboarding. The seats, rostrum, and other joinery are of pitch-pine. In addition to two entrances from the main street, access may be obtained to the gallery level from a side-door, which also communicates with the vestries and the new schoolroom. A hot-water heating apparatus is installed. Messrs. Habershon, Fawckner & Co., Newport and Cardiff, prepared the plans, and the building has been carried out by Mr. C. Shopland, Newport. The cost of the work is from 5,000*l.* to 6,000*l.*, and the accommodation is for 750.

NEW CHURCH, SANDECOTES.—The corner-stone of the new and permanent Church of St. Luke the Evangelist, being erected in Wellington-road, Sandecotes, was laid on the 24th ult. The church, accommodating 700 persons, will consist of nave north and south aisle, chancel aisle, organ-chamber, a clergy vestry and large choir vestry, and will have a clearstory and arcade. It will be lighted by electricity, and heated by hot-water radiators. The exterior is being built of local bricks, with Bath stone dressings. The joint architects are Mr. J. Henry Ball and Mr. T. J. B. Holland. Messrs. Goddard & Sons, builders, of Farnham and Dorking, are carrying out the work.

ST. ALDHELM'S CHURCH, BEDMINSTER.—On the 25th ult. this church was consecrated by the Bishop of Bristol. At present only the eartern part of the church, the vestries, and three bays of the nave are built, accommodating about 500, including the temporary use of the organ-chamber for seating a portion of the congregation. When the church is completed by the addition of the remaining three bays of the nave the accommodation will be for 750, including the choir. The architects of the building were Messrs. W. V. Gough & A. R. Gough, and the contractors Messrs. G. Humphreys & Son, all of Bristol.

ST. BRIDE'S CHURCH, GLASGOW.—The nave of St. Bride's Episcopal Church, Kelvinside, Glasgow, was dedicated on the 25th ult. The building is the work of Mr. G. F. Bodley, R.A. So far the nave has been completed, and the whole of the foundations to the floor level westward. A light roof covers the space between the nave roof and temporary brick walls, allowing for some 750 sittings. The nave is 102 ft. long by 26 ft. wide. Within and without the building is entirely of red stone. A feature of the approach to the west end is the flight of thirteen steps leading to the west door. The steps, which are from 25 ft. to 30 ft. long, have a 15-in. tread and a 6½-in rise, and are of a fine axed Corrienne granite. The cost of the present structure will be about 6,000*l.* The church, when completed, will have chairs for 950, but might hold on an emergency 1,200, and will consist of nave, three aisles, and chancel. The entire length of the building will be 130 ft. by 80 ft. wide, and the height from floor to apex of roof 56 ft., or from the floor of the mortuary chapel 72 ft.; while the spire will rise to 100 ft. The aisles will be separated from the naves by arcades of five arches, supported by moulded and clustered columns, the arches rising to a height of 27 ft.

WESLEYAN CHURCH, HITCHIN.—The new Wesleyan Church at Pirton, near Hitchin, was opened on May 29. The building consists of a church 43 ft. long by 27 ft. wide, seating 220 adults, or about 256 in a mixed congregation. The church has three arches at pulpit end, on columns, the central arch opening into the choir with a handsome traceried window in gable, and the two side arches opening into two vestries, which are shut off from the church and choir by swivel partitions, but can be thrown into it for extra accommodation when required. The seating and roof timbers are of pitch-pine. Separate porches lead to the vestries. A bold narthex projects in front of church with wide doors, and a five-light traceried window in gable above, flanked by two bold angle buttresses. Low-pressure hot-water heating and ventilation on modern principles are provided. The church stands on an open site, well set back from and raised above the road, showing the building to advantage. The exterior is faced with red bricks, with sandfaced terra-cotta dressings, lead lights with rich-coloured glass in the windows. The works have been carried out under contract at 972*l.* 10s. from the design

and under the superintendence of Messrs. George Baines & Son, architects, Clement's-inn, Strand, London.

PRIMITIVE METHODIST CHAPEL, BILLY ROW DURHAM.—The Primitive Methodists of Billy Row propose to erect a new chapel in the neighbourhood of Pease's West, Crook. The building will cost about 1,000*l.*, and the architect is Mr. George Race, of Westgate, and the builder Mr. William Lister, of Crook.

WESLEYAN METHODIST CHAPEL, BALDERTON, NEAR NEWARK.—A new chapel is being erected at Balderton for the Wesleyan Methodist community at an estimated total cost of 3,000*l.* The building is of stone, and will be capable of accommodating from 200 to 300 people. The builder is Mr. W. M. Smith, of Newark, the architects being Messrs. Brewill & Baily, of Nottingham.

BAPTIST CHAPEL, LLANDRINDOD.—The new Baptist Chapel in High-street, Llandrindod Wells, was opened a short time ago. The structure is built with bricks, faced with best Ruabon red bricks, and bath stone windows, doorways, coigns, copings, and pediments. The chapel has three mullioned and traceried windows in nave and transepts. All the windows are glazed with cathedral tinted glass, and hoppers have been placed in each window. Extraction of the vitiated air is ensured by a 24-in. electrically-driven fan fixed in a chamber above ceiling level, with a 24-in. zinc tube to conduct the vitiated air from three gratings in ceiling to chamber. Inside the building a gallery runs along the sides and one end, fronted with a cast-iron O.G. open pattern balustrade. Behind the rostrum are the choir gallery and organ chamber. The baptistery is fixed in front of the rostrum, and is lined with white glazed bricks. At the rear of the chapel are minister's, choir, and ladies' vestries, with lavatories, etc. The building will be heated with hot water on the low-pressure system, with radiators from a national ideal boiler. It has an electric light installation, and is fitted with the new Tantalum 100-c.p. lamps, and patent switch-board for controlling speed of fan. Owing to the contour of the land it has been possible to provide, underneath the chapel but all above ground level, a schoolroom, two classrooms, caretaker's apartments, with lavatories, boiler-house, coals and stores. The site will be enclosed by a wrought-iron fence on York stone coping. The cost will be 5,000*l.* The building has been erected by Mr. George Bullock, of Shrewsbury, from plans prepared by Mr. E. Peters Morris, architect, of Llandrindod Wells.

WELSH CONGREGATIONAL CHAPEL, HEOLYCYW.—A new chapel has been erected at Heolycyw by the Welsh Congregationalists. The new building was designed by Mr. W. J. Davies, of Tondu, and provides accommodation for over 400 persons.

NEW BOARD SCHOOL, DALMUIR, N.B.—The Kilpatrick School Board have opened a new school in the Station-road, Dalmuir. The building, which has been erected from plans prepared by Mr. D. Andrew, jun., architect, Glasgow, provides accommodation for 1,420 pupils, and the total cost is expected to be about 19,000*l.*, exclusive of the site.

ELEMENTARY SCHOOL, GOSPORT.—A new elementary school has been erected on a site in Clarence-square, Gosport. The school is on the central hall plan, and the six classrooms round the hall provide accommodation for 330 boys. The floor is laid with maple blocks. Internally the walls are of buff brick. A teachers'-room and store-room are provided, while some cellars in the basement have been retained and improved. At the rear is a tar-paved playground with an area of 670 super. yds. The school has been furnished with dual desks made of orham or Canadian oak, supplied by the Bennet Furnishing Company, of London. The buildings are heated by a low-pressure hot-water apparatus, installed by Messrs. Musgrave & Co., heating engineers, of Belfast and London. Radiators are placed in the central hall, and 2-in. pipes run round all the classrooms, the heating of each room being separately controlled. The cloak-rooms are also heated. The builders' contract, including the heating system and the tar paving, amounted to 4,346*l.*, and the total cost, including site, furniture, etc., was just over 6,000*l.* Mr. Frost, the Surveyor of the Council, was the architect, and his design has been carried out by Messrs. C. J. Lear & Son, of Alverstoke.

PROPOSED HIGH SCHOOL, GOVAN, N.B.—The Govan Parish School Board are about to erect a new high school upon a site in Langlands-road. Its plan is roughly in the form of the letter H, the laboratories and workshops being accommodated in the wings. In this wing accommodation there are, on the ground floor, wood and iron manual instruction workshops, with space for drawing benches, a physical laboratory for forty pupils, and a mechanical laboratory for twenty pupils. On the upper floor are placed a chemical laboratory for twenty pupils, providing also a balance-room and store for apparatus; an art-room, with lofty windows giving a north light; a mathematical laboratory in connexion with the mathematics classes; a cookery department, with practical cookery-room for twenty pupils, and a demonstration-room to seat fifty-four pupils. For class work there are ten classrooms for supplementary classes, each seated for forty pupils at dual desks, the floor space being 12 ft. to each pupil. There are also ten classrooms for secondary departments, each seated with single desks, for thirty pupils at 16 sq. ft. each. There is a central front entrance, at which are headmaster's-room and a large common room for teachers where the work of correcting exercises will be carried on. There are separate retiring-rooms for male and female teachers. The classrooms are arranged round a central hall, with gallery on the first floor. The hall is top-lighted. The stairs, at each end of hall, are open and visible from all parts, and debouch in the direction and line of the exits. A feature of the plan is that the latrine and lavatory accommodation is connected to the school on the hospital plan of cut-off ventilated wings. The plan, which was accepted out of twenty-nine sets submitted in competition, is by Messrs. H. & D. Barclay, architects.

SCHOOL EXTENSION, FALKIRK.—The new additions to Camelon Public School which have been completed for Falkirk Burgh School Board were opened recently. The new building, which is of two stories, includes ten classrooms, a cookery-room, boys' and girls' cloak-rooms, and teachers' accommodation. Provision is made for 580 scholars, and the cost of the reconstruction and extension, exclusive of fittings and furnishings, has amounted to 4,800*l.* The architects were Messrs. A. & W. Black, Falkirk.

CLIFF COLLEGE, CURBAR.—On the 20th ult. the chapel adjoining Cliff College, Curbar, was reopened after being enlarged and entirely remodelled. The new building is in harmony with the general character of the adjacent college. The walls are of local stone, and the windows are of stained glass. Originally the chapel seated about 125. Now the accommodation is approximately for 250. The whole of the buildings and fittings have been designed by Mr. Frank W. Chapman (Messrs. Hemsoll & Chapman), of Sheffield, and the work has been carried out by Messrs. Thomas Allsop & Son, contractors, of Bakewell.

CHURCH ROOM, HORTON.—A new church room has been built in connexion with St. Peter's Church at Horton. The room, which is built on the west side of the church, is connected to the porch by a passage. It is of stone, with a red tiled roof. The work was carried out by Messrs. W. Coombes & Sons, builders and contractors, of Ilminster; and the architect was Mr. G. W. Warry, of Ilminster.

NEW RECTORY, FINNINGHAM.—A new rectory is being erected in connexion with the Finningham Parish Church. Mr. Eustace Frere, of London, furnished the design. The builders are Messrs. Cornish & Gaymer, of North Walsham.

THE FRENCH CONVALESCENT HOME AT BRIGHTON.—A new wing has been added to this institution. The extension is built of red brick and terra-cotta, and the cost has been about 2,500*l.* The additional beds number eighteen, each bed having a surrounding cubicle and its own window. Messrs. Clayton & Black were the architects of the work.

EXTENSION OF THE CARDIFF POST OFFICE.—Work has just been commenced on the enlargement of the General Post Office building at Cardiff. The extension will be at the south end, overlooking Park-street. The scheme provides for raising the elevation to correspond with the Westgate-street frontage, both in height and design. The new portion will be built over the present postmen's sorting-room and loading platform, and will be three stories high. Messrs. Wm. King & Co., Westminster, are the contractors and the cost of the work will be about 20,000*l.*

CLUB PREMISES, NEWARK.—New premises have been erected for the Newark Conservative Club in Carter-lane. The club occupies the upper story of the new buildings, there being three shops underneath. The billiard-room and reading-room are divided by a movable partition, and can be thrown into one large room. There is also a separate smoke-room. The architects were Messrs. Sheppard & Lockton.

INSTITUTE, LONGSTONE, DERBYSHIRE.—A new institute has been erected in this village. The work has been carried out by Mr. A. W. J. Eyre, and Mr. W. J. Eyre was responsible for the plans. The main room is 52 ft. in length, and its width is 24 ft. It is divided by a movable partition, to make a billiard-room, but there are also kitchens, stores, etc.

NEW HOSPITAL, POOLE.—The opening of the new Cornelia Hospital, at Poole, by Lady Wimborne, took place on the 23rd ult. The plans for the hospital, which provides accommodation for seventeen beds, were drawn by Mr. Walter Andrew, architect, of Parkstone. The tender of Messrs. A. & F. Wilson, builders, of Parkstone, was accepted at 3,369*l.*

PRINTING WORKS, BRISTOL.—New printing works have been erected in Host-street, Bristol, for Messrs. John Wright & Co. Mr. W. S. Skinner, architect, prepared the plans for the work, which was executed by Mr. Alfred Dowling.

PROPOSED NEW OFFICES, CARDIFF.—In order to provide better office accommodation at the Cardiff Docks it is proposed to erect a new block of offices in Mountstuart-square. Plans have been prepared by Mr. Henry Budgen, architect, for a building which may cost about 20,000*l.* on a freehold site now occupied by the National School, at the entrance to Mountstuart-square from West Bute-street. The outside facing will be of Bath stone, but the interior construction has not yet been decided upon.

NEW BUSINESS PREMISES IN OXFORD-STREET.—New premises are in course of erection for Messrs. D. H. Evans & Co, Ltd., in Oxford-street. The work is being carried out from the designs of Mr. John Murray by Messrs. Saml. Haskins' Brothers.

THE BUILDING TRADE AT TODMORDEN.—Mr. J. A. Heap, the Todmorten Borough Surveyor, in his annual report, states that during the past year 142 plans of houses have been before the Town Council, of which seventy-four have actually been erected. This is a larger number than has been built since 1898, and has only been exceeded five times during the last twenty-five years.

RESTORATION OF ST. ANDREW'S TOWN CHURCH, GLASGOW.—It has been decided to restore St. Andrew's Town Church at an estimated cost of 21,300*l.* Mr. Macgregor Chalmers is the architect of the proposed work.

Stained Glass & Decoration.

COLDSTREAM U. F. CHURCH.—Messrs. Percy Bacon & Brothers, of London and Edinburgh, have just placed in this church two stained-glass windows, one a memorial to the late Robert Carmichael, of Coldstream, for many years session clerk and treasurer of the congregation, and of his wife; and the other window was erected as a recognition of the generosity of Mrs. Agnes Black, of Lamton, who built the church. These windows each contain six lights and tracery, the lights of the memorial window containing the following figures:—Margaret, Dorcas, Mary, Agnes, Hannah, Miriam, with appropriate texts over each, and in the other window two subjects are depicted in the central lights—"Christ healing blind Bartimæus," and "Christ healing man with withered hand," while in the adjoining lights are figures of Faith, Hope, Charity, Justice.

Sanitary and Engineering News.

WICK HARBOUR EXTENSION.—The Wick Harbour Trustees recently obtained a Provisional Order to enable them to enlarge and improve the harbour. The plans have been sanctioned by the Board of Trade, and the Trustees have made an application to the Public Works Loan Commissioners for a loan of 70,000*l.* This sum, along with a Treasury grant of 20,000*l.* which has been obtained, will meet the proposed expenditure upon the new works, which are estimated to cost 90,000*l.* The works authorised by the Order are estimated to cost 150,000*l.*; but meantime it is proposed to restrict them to 90,000*l.* Before a loan is granted the Public Works Loan Board, in order to satisfy themselves, have sent their consulting engineer, Mr. W. T. Douglas, C.E., London, to inspect the harbour and report on the proposals. Mr. Douglas, accompanied by Mr. James Barron, M.Inst.C.E., Aberdeen, the engineer to the Trustees, and who prepared the plans, concluded his inspection on the 13th inst.

SHOREHAM HARBOUR.—The trustees of this harbour have instructed Mr. A. T. Walmisley, M.Inst.C.E., to engage the services of an experienced contractor to execute such protective works as would prove serviceable pending their consideration of a tidal harbour. The width proposed for such tidal passage at the site of the lock is 130 ft., and if carried out as proposed in the engineer's report of May 6, will permit of a temporary tidal passage of 50 ft. wide being reserved on the south side during the construction of a new lock 45 ft. wide on the north side. To form the side walls, sluices, and gate-sills, a temporary dam would be built in the centre of the 130 ft. way enclosed by return ends on the east and west sides, which dam would be cleared away at completion and the space serving as the temporary south channel filled in.

ANOTHER CONFERENCE ON COMBINED DRAINAGE.—On June 24 a conference of delegates of Metropolitan Borough Councils will be held with regard to combined drainage. The conference is convened by the St. Pancras Borough Council, which intimates that the object is "to relieve the Metropolitan sanitary authorities from the heavy and inequitable burden of the maintenance of combined drains originally laid as drains by mutual implied agreements between the original constructors of these combined drains and the late vestries and district boards."

The circular convening the meeting goes on to say that inasmuch as the judgment in the case of Travis *v.* Uttley placed a different interpretation on such implied agreements from that accepted by the contracting parties when such agreements were made, the burden in St. Pancras alone has considerably increased, and amounts to between 2,000*l.* and 5,000*l.* per year. Mention is further made of the fact that the President of the Local Government Board is reported to have said that although he could not give any pledge to promote legislation this session, he would be ready to consider any measure which may be introduced on behalf of the borough councils.

NEW BRIDGE, TUNBRIDGE WELLS. — The reconstruction of the High-street Bridge at Tunbridge Wells has been completed. The bridge which spans the South-Eastern and Chatham Railway line practically connects the two halves of the borough. The abutments, piers, etc., of the new structure were constructed by the railway company's men, the ironwork being executed by the Widnes Foundry Company, Ltd. Both main girders are .10 ft. in height, that on the London side being 108 ft. long, and weighing 52 tons, and that on the Hastings side 68 ft. long and 26 tons in weight. The total weight of the steelwork in the bridge is 461 tons. The kerbing, paving, and roadway surfaces have been carried out by the Corporation, the contractors for the wood paving being the Acme Flooring and Paving Company, Ltd., and for the *in situ* paving at the Vale-road end the Stuart's Granolithic Company. The area of the old bridge was 290 sq. yds., which has now been increased to 579 yds. The asphalt work covering the steel troughing was by Messrs. Callender, and the bronze panels and standards on the piers by the Coalbrookdale Company. The piers are of Cornish grey granite. The main girders, columns, etc., have been painted with four coats of "Ferrodor" paint. The work was carried out under the supervision of the Borough Surveyor, Mr. William H. Maxwell, A.M.I.C.E., who has represented the borough, and Mr. P. C. Tempest, M.Inst.C.E., the chief of the engineering department of the South-Eastern Railway.

DERWENT VALLEY WATER SCHEME.—A report of the Derwent Valley Water Board has just been issued. With regard to the Bole Hill Quarries, out of the estimated quantity, 1,200,000 tons, of stone required for the two dams now in course of construction 589,410 tons had been turned out at the end of the period covered by the last report, on December 13. Between December 13 and March 14 32,688 tons more had been obtained, making the total output 622,098 tons. The dressed stone prepared at the quarries amounted to 22,802 sq. yds. On the reservoir works the estimates for the Howden dam are 250,000 cubic yards of excavation and 320,000 cubic yards of masonry. On March 14 the work done equalled 232,155 cubic yards of excavation, 124,160 cubic yards of masonry in main dam, and 8,225 cubic yards of concrete in heel trench, the work done during the quarter being 6,893 cubic yards, 5,505 cubic yards, and 1,206 cubic yards respectively. The pumping had increased, the daily average for the three calendar months ended March 14 being about 690,000 gallons, as against a daily average of about 639,000 gallons for the previous three months. As to the Derwent Dam, 320,000 cubic yards and 360,000 cubic yards are the respective estimated figures for excavation and masonry, and the work done at December 13 was:—Excavation, 254,771 cubic yards; masonry in main dam, 138,504 cubic yards; and concrete in heel trench, 4,304 cubic yards. These figures had been increased by 7,880 cubic yards, 8,529 cubic yards, and 1,116 cubic yards, making the totals to the 14th ult. 262,651 cubic yards, 147,033 cubic yards, and 5,420 cubic yards. The daily average for pumping, for the same three months as mentioned in the case of Howden, had been about 640,000 gallons, as against a daily average of about 608,000 gallons for the previous three months. Steady progress has also been made with the various sections of the aqueduct works. The number of workmen engaged at March 13 on the various works of the Board was 1,576 and of these 1,002 were in the direct pay of the Board. The total expenditure up to date has been 1,385,482*l.* 19s. 2d., the expenditure for the year amounting to 87,721*l.* 5s. 4d., the income and deficits for the year totalling 32,790*l.*

WATERWORKS, STANLEY AND WEST HALLAM, DERBYSHIRE.—On the 25th ult. the Hon. Mrs. Newdegate opened the new waterworks, which supply a population of 2,000. The water is supplied by the Mapperley Colliery Company, and pumped into a covered reservoir holding 90,000 gallons, from which it is distributed through 5½ miles of service mains, varying from 6 in. to 3 in. in diameter. The amount borrowed for the works is 4,600*l.* Mr. G. F. Tomlinson, of Derby, was the general contractor. The Stanton Ironworks Company supplied the iron pipes, and the engineers to the scheme were the Messrs. Elliott & Brown, Nottingham.

Foreign.

SOUTH AFRICA.—Trade at Cape Town has probably never been in such a bad state as it is at present. The work on the new wing of the Dominion Tobacco Factory is now in full swing; the contract for the foundation of the new Law Court has at last been placed with Messrs. A. B. Reid & Co., the contract price being some 6,000*l.* odd.——A meeting of the municipal ratepayers held at Port Elizabeth authorised the Town Council to borrow a further sum of 25,000*l.* to complete the electric lighting scheme; the original estimate of the cost of this scheme was 86,358*l.*, but when completed will cost the ratepayers some 120,000*l.*, being about 40,000*l.* more than originally estimated at.——The new Government School at Vogelfontein, Boksburg, is rapidly nearing completion. The school is built to accommodate 450 pupils. It consists of a central hall of 28 ft. by 50 ft. by 23 ft. high, seven classrooms, three teachers'-rooms, three lavatories, and in addition to this there are the usual outbuildings. Messrs. White & Leo are the contractors to plans by the Public Works Department. The school when finished will cost some 6,000*l.* Lord Selborne laid the foundation-stone on October 31 last.——The valuation roll of Pretoria for the present year gives the value of the lands and buildings at a total of 9,892,473*l.* This is a decrease of a little under 25,000*l.* on last year's roll.——Nine tenders were received by the Municipality of Johannesburg for the supply and delivery of Portland cement for the current year. The lowest tender was that of the Portland Cement Factory, at the rate of 8*l.* 8s. per ton, which was accepted. Tenders are at present being called for the supply and delivery of 3,000 casks of cement to be delivered on the works at the third section of the South West Outfall Sewer, delivery to be at the rate of about 200 casks per week.——Messrs. Prentice & Mackie are the successful tenderers for the new Customs House which is to be erected at the Kazerne, Johannesburg; the plans are by the Public Works Department.——At the meeting of the Central Committee of the Stewart Memorial Fund, at King Williamstown, it was resolved that the memorial to the late Dr. Stewart, of Lovedale, should take the form of a monument and obelisk erected near the grave at Sandilli's Kop, the cost not to be less than 1,000*l.* Competitive designs will be called for. Up to the present Dr. Jameson has given 100*l.*, and a further similar sum has been promised.——The Town Council of Port Elizabeth have received a report from Mr. Butterworth, the Town Engineer, for the construction of a drainage scheme for the town at a cost of 250,000*l.* The report will be considered in a week's time.——The council at Klerksdorp have done some splendid work on roadmaking. A considerable portion of Church-street, the principal thoroughfare of the town, has been altogether made in a first-class permanent manner; they are also repairing and making new streets and drains, etc.——Tenders are being called for the periodical external painting of the Government buildings at Robert's Heights and the sub-district, Pretoria.——Mr. Hoskins, of Krugersdorp, is the architect for the New Town Hall there. Messrs. Blackwell & Co. are about to build new premises in Human-street; the buildings will possess special arrangements for cold storage and for the handling of perishable goods.——At a meeting of the Council of the Institute of Architects, held a short while ago at President-buildings, Johannesburg, Mr. Walter Reid, F.R.I.B.A., was voted to the chair, and afterwards appointed to act as President in the absence of Mr. G. Burt Andrews, who is now in Europe. The secretary reported the action that had been taken with reference to the forthcoming architectural competitions for buildings at Bulawayo, Potchefstroom and Germiston. The tender of the First Pretoria Portland Cement Factory for the supply and delivery of 3,000 casks of cement to the third section of the South-West Outfall sewer has been recommended for acceptance by the Council; their tender was at the rate of 8*l.* per ton.——The committee of the Transvaal University, Johannesburg, have amended the conditions of the contract, and thereby met the request put to them by the Master Builders' Association. Mr. Seton Morris, the architect, left for a short holiday in England. During his absence his practice will be superintended by Mr. St. J. Cottrill.——The Municipality of Johannesburg are inviting tenders for the erection and completion of a tramway car-shed at Turffontein.——The Town Council of Barbeton have decided to expend the sum of 500*l.* for the purpose of lighting the town. The Alladin lamp has been selected as the cheapest, after several systems having been tried.——The foundation-stone of the municipal abattoirs, Krugersdorp, has been laid by the Mayoress. The function was wholly confined to members of the council. The abattoirs when completed will form a fine structure. These are the first approved abattoirs ever built in South Africa. Messrs. Birnie Bros. are the contractors; the plans are by the municipal engineer. The contract price is 3,200*l.*

GERMANY.—The first premium of 1,600 marks was awarded to Herr Karl Wiener, of Mannheim, in the competition for a national school and gymnasium for Ludwigshafen-am-Rhein.——The new municipal offices in Bomberg, opened last year, were designed in the Public Works Department under the direction of Herr Saal. The design is in the Early Renaissance style, and is carried out in cemented brickwork, with basement of rough hewn and dressings of dressed sandstone. The roof is of corrugated pan-tiles. The total cost of the building amounted to 374,000 marks, or 16 marks per C.M.——Dr. Rud. Eberstadt, lecturer to the University of Berlin, has published a book on "Speculative Building in Modern Towns," in which he offers valuable information on the important question of the housing of the working classes as viewed from the political economy aspect. The majority of the promoters of town dwellings see that their main task is now to prevent the spread of large tenements and to combat crowded dwellings and those other evils rife in land speculation and house ownership. Dr. Eberstadt finds the only solution to the dwelling-house question in the differentiation between land and building in mortgages. The value of land built upon in Berlin is over 7½ milliards, while the mortgages amount to 6½ milliards. Most of the workmen's flats in Berlin are courtyard tenements, with no through ventilation and with flights of stairs innumerable, the rent for a kitchen and bedroom being 312 marks, whereas in Eberfeld-Barmen the rent for the same accommodation, but with outlook on the street, is 190 marks. These blocks, so far from lowering rents, have raised them and simultaneously raised the price of land. The housing question has been started in Berlin on this account, that in the outlying quarters the rent of a two-roomed tenement has risen threefold, while the price of wheat has fallen considerably. Many writers maintain that the perfection of means of communication is the chief method of lowering the value of land in towns. The assertion of Voigt and Gelder that communication is easier in densely-built towns than in more expanded plans is regarded as incorrect. In London, New York, and Chicago the means of communication are far nearer perfection than in overcrowded towns like Berlin and Paris. Against the assertion that the cost of building per square metre of dwelling space is lowered in proportion as the building is higher, Dr. Eberstadt quotes as follows:—Fabarius calculates that for three-storied houses the cost is no longer diminished, while in five-storied houses it is actually increased; that in Düsseldorf the cost of building three-storied houses with small dwellings is 8 per cent. cheaper per square metre than the cost of erecting five-storied houses in Berlin. In Dresden the authorities advocate, on economical grounds, small houses in preference to the tenements built hitherto; and it is stated that in 417 blocks used by the State for housing their officials there is a distinct increase in the cost of construction in direct proportion to the number of stories built.

ROME.—In the course of his annual report, just presented to Parliament by the Foreign Office, Mr. Consul Morgan observes that after a somewhat protracted period of economic depression Rome has awakened to a new existence. The population of former times, who had never devoted themselves to business pursuits, and who had but very imperfectly felt the necessity of doing so, have developed, by gradual amalgamation, with the new-comers from the rest of the peninsular and from abroad, into quite a different race, largely composed of enterprising men, anxious to place Rome on a footing similar to that of other prosperous European capitals. Their first endeavours were directed towards rebuilding and modernising the old city, but at the outset inexperience led them to commit grave errors, with the result that they found themselves involved in a disastrous crisis which was ruinous to a great many people. A period of depression followed, but gradually the position began to improve. The population increased so rapidly that the new houses not only became fully tenanted, but a dearth of apartments is at present keenly felt, especially by the less-favoured classes of society. Within the brief period of thirty-seven years modern Rome has been almost rebuilt, and by comparing a map of 1870 with one of the present time, it can be seen at a glance that its topography has altered considerably. Strenuous efforts are being made to encourage the establishment of manufactories. The possible harnessing of a portion of the Tiber and of the waterfalls near Rome, as a motive power, the recent substantial 50 per cent. reduction on the import duty on petrol, the proposed reorganisation of the electric supply services, and other reforms of a wide public character, will undoubtedly exercise considerable influence in the attainment of the desired end. The pretty small towns and villages near Rome are now served by a regular electric tramway service. The country is being gradually opened up, and

symptoms of activity are everywhere discernible. The two railway stations in Rome, known as Termini and Trastevere, are to be shortly connected by means of a direct line, and the workshops, as well as the stores connected with the railway service, will be transferred to the Trastevere station, thus relieving the present congested Termini station. The cost of the undertaking is estimated at 250,000*l.* Another important scheme, which is receiving serious attention, is the one relating to a new road to the sea, almost parallel to the course of the Tiber. A small harbour is to be built on the left side of the river's outlet into the sea. Besides facilitating the conveyance of goods to Rome by means of the proposed approach to the capital from the sea, it is intended to convert the new harbour into a summer resort readily and quickly accessible from the capital by means of a regular electric tram service.

GREEK MARBLES.—The British Consul in the Piræus reports that the firm which practically controls the entire marble business of the district have during the past year been taking active steps in the development of their quarries and the installation of costly and improved plant. Towards the end of 1906 a large demand for Pentelicus marble came simultaneously from the United Kingdom and the United States of America, and during 1907 several thousand tons are to be shipped to these countries. The shipments abroad in 1906 showed a slight decrease when compared with the average tonnage of previous years, but, on the other hand, the value of marble was higher. The decrease may also be accounted for by the development in the output of machined or dressed marble, a large number of memorials, headstones, and crosses having been shipped to Europe and India.

Miscellaneous.

PROFESSIONAL AND BUSINESS ANNOUNCEMENTS.—Mr. W. Bevan, architect, has removed his offices from 90, Parliament-chambers, Great Smith-street, to 2, Old Queen-street, Westminster, S.W.——The firm of Messrs. Ellkay & Cornes, bath and range makers, is now changed to that of "Ellkay & Co., Ltd.," Mr. Cornes having no further connexion with the firm. The registered office will still be Bath House, 59, Holborn-viaduct, but increased accommodation has been taken for London stock, general offices, warehouse, and showrooms, of which notice will shortly be given.——The Nautilus Fire Company have recently acquired new showrooms at 215, Tottenham Court-road, London, W., which have now been fitted up and stocked with their new Nautilus grates, mantelpieces, and new productions in kitchen ranges.

TRENTHAM HALL.—In July will be sold at Trentham Hall the art collections, which consist of ancient and modern sculptures in marble and bronze, including examples of early Grecian, Græco-Roman, and Roman work, with fonts, vases, etc., and pictures, engravings, furniture, and china.

EAST HAM MUNICIPAL BUILDINGS. — Mr. Hooper, the Local Government Board Inspector, has opened at the Town Hall a public enquiry into the Borough Council's application for a provisional order relating to the erection of municipal buildings under the East Ham Improvement Act, 1898. It appears that an expenditure of 23,000*l.* has arisen in excess of the authorised outlay of 55,000*l.* upon public offices, a police-court, public library, technical college, coroner's court, and other buildings as yet incompleted—after plans and designs by Mr. Cheers. It was stated in evidence that the site cost 5,000*l.*, or nearly 1,000*l.* per acre, and Messrs. Barker & Co.'s tender for 30,650*l.* was accepted, and that a total sum of 42,920*l.* 15s. 9d. was paid to the contractors for the main building, whilst the contract price for the clock tower was 3,233*l.* in addition, and that the boundary wall, 630 ft. long, cost over 3*l.* per foot besides. The Council's application is opposed by representatives of the Ratepayers' Association and the Municipal Alliance. The borough debt is 950,672*l.*, and the rates are 9s. 7d. in the pound.

JOHN FINNIE EXHIBITION.—An exhibition has been opened in the Walker Art Gallery, Liverpool, of the works in oil, water-colour, pastel, and black and white of the late John Finnie, Director of the Liverpool School of Art. Dr. N. Harrington has selected and catalogued a collection of 440 examples, which include 130 etchings and mezzotint engravings.

CROWN LANDS, PICCADILLY.—The Commissioners of H.M.'s Woods, Forests, and Land Revenues are about to let for an eighty years' building lease the sites of Nos. 174-5-6, Piccadilly, and Nos. 52-3 (the Brunswick Hotel), Jermyn-street, at the rear. The three houses in Piccadilly are on the south side and stand next eastwards to the buildings which have recently been erected upon the site of the Egyptian Hall and some adjoining property.

SALE OF BOOKS, ENGRAVINGS, ETC.—In a sale at Christie's rooms a few days ago were included six hundred engravings by Hollar—37*l.* (Gutekunst); a collection of engraved views, portraits, and so on, upwards of 1,700 in number, arranged for illustrating Granger's "History," in six folio volumes—34*l.* (W. Daniell); H. and J. A. Repton's "Fragments on the Theory and Practice of Landscape Gardening," 1816—21*l.* (Cox); John Smith's "Catalogue Raisonné of the Works of the Dutch, Flemish, and French Painters," 1829-42, bound in morocco—28*l.* (Quaritch); T. Chippendale's "Le Guide du Tapissier, de l'Ebéniste," etc., 1762, with 200 plates—27*l.* (Quaritch); and J. Chaloner Smith's "British Mezzotinto Portraits," 1884, with 125 autotype plates—28*l.* (Gooden & Fox).

"LIVING" STATUARY.—Mr. Toft, the sculptor, has prepared a series of representations for the London Hippodrome to show what living statuary should be from the artist's and sculptor's points of view. He poses living models, with appropriate surroundings, of Lord Clive, Lord Beaconsfield, and Sir Henry Irving, and of certain popular personages of the present day.

SALE OF CROSBY HALL.—Crosby Hall, in Bishopsgate-street, one of the oldest and most famous historical edifices in the City of London, has recently been sold by the freeholder, Alderman Sir Horatio Davies. Whether it will continue to be used as a restaurant or demolished is not yet known. It was originally built by Alderman Sir John Crosby in 1466 on ground leased from the adjacent convent of St. Helena. Richard, Duke of Gloucester, purchased it from his widow, and it became a palace in name as well as reality. It was in 1483 in the council chamber of Crosby Hall that the Crown was offered to Richard by the Mayor and a deputation of citizens. Crosby Hall immediately afterwards became the official residence of the Chief Magistrates of the City. Sir Thomas More was another distinguished occupant of Crosby Hall. The old hall escaped the Great Fire of London. A fine specimen of Roman tesselated pavement of the probable date A.D. 275 was found in making the foundations for a new wing and has been inserted in one of the walls. If the recent sale leads to the demolition of a building of such great antiquity and historical interest, it will cause great regret. Sir Horatio Davies has, it is understood, reserved to himself the right of retaining and removing anything of antiquarian and archæological value which he may wish to possess.—*Times.*

HAMMERSMITH WORKHOUSE.—Messrs. Giles, Gough, & Trollope, architects, Craven-street, Charing-cross, write to the *Times* with reference to the statement made by Mr. Burns in the House of Commons on May 13, that the cost of the Hammersmith Workhouse and Infirmary was 335*l.* per bed:—"Such a statement without qualification is misleading, unfair to the guardians, and calls for a public explanation. This cost of 335*l.* per bed is calculated on the present accommodation for 758 inmates, but with administrative buildings, kitchen, laundries, etc., for 1,456 inmates. The necessary blocks for the additional 698 inmates will cost 80*l.* per bed, and when these are erected the cost of the Hammersmith Workhouse and Infirmary will be 138*l.* per bed."

LESTER MEMORIAL, LIVERPOOL.—The memorial of the late Canon T. Major Lester, in St. John's-garden, was unveiled by Lord Derby on the 25th ult. The memorial consists of a colossus bronze statue which stands on a base, and represents the late Canon with a child in his arms. The sculptor was Mr. G. J. Frampton, R.A.

ROMAN REMAINS IN THE PEAK DISTRICT.—The Derbyshire Pennine Club have recently been carrying on excavations at Rainster Rocks, in the Peak district, and have made some interesting finds. Four bronze coins which were found have been assigned by Mr. John Ward, F.S.A., to the period A.D. 250-280. There was also unearthed a quantity of ironwork, including an axe-head, a buckle, and a miniature sickle hook, while many varieties of pottery, embracing no fewer than thirty-five different designs of rims, were discovered. Among the other finds are part of a quern, or handmill for grinding corn, a piece of grey glazed ware, representing Roman "engine turning," bottle neck and flat dishes, fragments of "Samian" or Rhenish pottery.

RECENT DISCOVERIES OF ROMAN REMAINS IN LONDON.—Now that the work of excavation for the foundations of the new Post Office building, which is to occupy the site of the old Bluecoat School, is well in hand, states the *Daily Graphic*, it is expected that a considerable length of the old Roman wall of London will be found, as it is known to have extended across the northern portion of the site. A portion of it has already been found in the extreme north-eastern corner, close to King Edward-street (anciently Butcher Hall-lane), and has been examined by the committee of the Society of Antiquarians, which is watching the progress of the excavations. The wall here is of the usual well-known type of Roman work—cement and flint, with courses of tiles, of great thickness and extremely hard. As the work of digging goes on it is probable that the foundation of the wall, which ran to a point just north of Newgate and then turned south and ran to the river at Blackfrairs, will be found. Besides the portion of wall already unearthed, fragments of urns—perhaps Roman burial urns—and of the red "Samian ware," have been discovered, but, so far, nothing apparently of great archæological value. The whole of this corner of ancient London—the north-western corner of the old walled town—is an interesting one, for it was the site of the great priory church of Christchurch, with its cloisters and monastic buildings, and it is quite possible that as the vast area to be occupied by the new Post Office building is broken up there may be brought to light not only more of the Roman wall but some relics of mediæval days.

LUNDIE MEMORIAL HALL, LIVERPOOL.—The hall and Sunday-school in Beech-street, Liverpool, erected in connexion with the Fairfield Presbyterian Church in memory of the late Dr. R. H. Lundie, was recently opened. Built from the plans of Mr. Herbert Aspinall, the main feature of the building is a hall 70 ft. by 40 ft., capable of seating 500 persons, but there are, in addition, twelve classrooms, fitted with sliding partitions. The total cost has been about 4,000*l.*

SLATE TRADE.—The mineral statistics for 1906 show an output of 492,663 tons, as compared with 515,642 tons in 1905, the net decrease being in the slate "mines" (or underground quarries), the tonnage from open quarries being practically the same as the previous year. It will, however, be found that there is a considerable increase in the Bangor vein quarries, counterbalanced by a decrease in those other districts, as the depression is less felt with Bangor slates than those of inferior quality.

THE SURVEYORS' INSTITUTION.—The Institution visit to Glasgow took place on May 23 and 24. On the first day the members assembled at the Windsor Hotel, where the Lord Provost of Glasgow welcomed them on behalf of the city. A conference followed, the President of the Institution being in the chair, and the following papers were read and discussed:—"Notes on the Small Landholders' (Scotland) Bill, 1907," by Mr. James Mather; "The Valuation Roll in Scotland, and the Proposals to enter Values upon it," by Mr. David Murray, M.A., LL.D.; and "Some Features of the Position of Scottish Agriculture," by Mr. Robert Wallace. After the conference the members of the Scottish committee entertained the visiting members to luncheon at the Windsor Hotel, and in the evening a dinner was held at the same place. The following day was devoted to excursions.

CHERBOURG STONE.—During the year 1906, according to the report of the British Consul, Cherbourg exported 81,119 tons of broken stone, mostly in British vessels, to ports of the United Kingdom. This quantity was 11,679 tons less than that exported in the previous year. The diminution is mainly due to keen competition by German, Alderney (Channel Islands), Cornish, and Scotch quarries, and to the constant labour troubles to which the Cherbourg companies have been exposed during the greater part of the summer months of 1906. As the stone is entirely broken by hand the want of manual labour obliged the companies to supply other stone instead, and, in some instances, relief from the contracts entered into had to be sought. The labour troubles and strikes have now in a measure settled themselves, and continued prosperity is looked for during 1907. In 1906 the Road Maintenance Supply Company, of Gravesend, exported 70,600 tons of quartzite road-metal to ports in the United Kingdom, the various other companies and private individuals shipping some 10,519 tons additional. The manager of the Road Maintenance Supply Company has assured the Consul that the area within which quartzite is now used in the United Kingdom shows a tendency to extend; his company recently received inquiries from Wiltshire, a county which has never previously used this stone. Nearly all the exports are now sent in British steamers instead of sailing barges and other small vessels as formerly. The steamers bring coal and load stone outwards, whilst the barges come in light and go out with stone.

Legal.

DISPUTE AS TO A BUILDING CONTRACT.

THE case of Brown *v.* Harding & Sons came before a Divisional Court of King's Bench, consisting of Justices Darling and A. T. Lawrence, on the 29th ult., on the appeal of the defendants from a judgment of an Official Referee on a reference under a building contract.

Mr. Foote, K.C., in support of the appeal, said the action was brought to recover a sum of money due under a building contract in which the usual dispute as to extras arose. Defendants had paid a sum of money into Court. They had no wish to dispute anything which they felt themselves in honour bound to pay, but they

considered that certain charges were made for extras contrary to a clause in the contract. The result of the legal proceedings was that defendants were ordered to pay 5*l.* 15s. 9d. more than they had paid into Court. It might be said that that was a mere trifle not worth appealing about, but the judgment carried with it the liability to pay considerable costs, and also involved a principle which was of considerable importance in the building trade. The point of law involved was whether a builder could recover for extras for which no written order had been given in the face of a condition in the contract that no extras should be paid for which had not been ordered in writing by the defendants. The contract was for the erection of some cottages at Workington, and defendants' case was that they were not liable to pay for certain extras on the ground that they had not been ordered in writing. The plaintiff's case was that defendants had waived the condition in the contract as to written orders, in proof of which it was said that defendants had seen the work on the disputed extras done, and that everything had been done at the suggestion of and with the consent of the defendants. He (Counsel) contended that the written condition of the contract could not be set aside, and that the Official Referee ought to have entered judgment for the defendants with costs.

Mr. Ashton, K.C., on behalf of the respondent, contended the facts of the case showed that there had been a waiver of the condition in the contract as to written orders.

In the result their lordships took this view, and dismissed the appeal with costs.

Patents of the Week.

APPLICATIONS PUBLISHED.*

7,728 of 1906.—F. VOLLMER: *H-Beams or Metal Bars.*

THIS relates to H.beams or metal bars with stems corrugated in longitudinal section, and is characterised in that the stems are provided with strengthening pieces at their flanges, the section of which corresponds to the lateral width of the longitudinal corrugations.

7,839 of 1906.—C. WILLETTS and A. H. ROTHAN: *Worm and Worm-wheel Pulley Blocks, Hoists, Lifts, and the like.*

This relates to a worm and worm-wheel pulley block, hoist, lift, or the like, in which the worm gear and the sprocket-wheel over which the lifting chain passes are each made with internally toothed clutches enclosing a sliding clutch made with external teeth adapted to engage with one or both of them, said sliding clutch being actuated by a spring so as to normally engage with both internally toothed clutches and connect the worm-wheel and sprocket-wheel together to turn as one piece, the sliding clutch being provided with an actuating lever by which each can be moved out of gear with one of the internally toothed clutches to allow the sprocket-wheel to revolve independently of the worm-wheel.

9,955 of 1906.—J. C. TOMLINSON: *Locks or Catches for Doors, and the like.*

This relates to a lock or catch comprising a slotted front plate, a plug or housing at the back thereof, a bolt adapted to slide within the latter, and a thumb-piece or pin for actuating said bolt, the plug being contained in a recess which is drilled through or out of the face of the door or the like, so as to merge into the edge.

10,222 of 1906.—A. METZ: *Application, Fitting, or Erection of Slabs or Facings for Building, and like Purposes.*

This relates to the method of fixing, fitting, or applying slabs or facings for building and like purposes made with the end composition of asphalt bitumen and granular stone and strengthened with a metallic skeleton, and consists in attaching the said slabs or facings to the framing members of the building or structure by claws, clamps, or the like carried by the slab or facing.

10,252 of 1906.—E. W. BROCK: *Construction of Glass Tiles.*

This relates to a backing for glass tiles, and consists in the use of paper which has been impregnated or coated with a mixture, and is applied to the glass.

12,312 of 1906.—H. H. LAKE (CEMENT MACHINERY COMPANY): *Machines for Moulding Bricks.*

This relates to a machine for moulding brick, comprising a frame, on which the mould with a hinged front and a removable pallet board is mounted, said mould being of greater depth than the finished brick, and a rockable member pivoted to the frame and carrying plates fitting into the mould, said rockable member constituting a stamper for compressing the plastic material, and also a top moulding face.

12,786 of 1906.—F. C. WOODFORD: *Chimney Tops.*

This relates to a chimney top having each of its cones stamped out of a single piece of metal, and having the said cones supported at the required distance from one another by angle stays cut with tongues at each end, the tongues being inserted in the slots provided in the cones and bent over on the upper and lower surfaces thereof.

13,968 of 1906.—J. R. PEIRCE: *Machines for Coping or Similarly Working Marble.*

This consists in the use, for coping marble, of a thin shell moulded integrally of carborundum so agglomerated that the particles thereof do not become disintegrated and act as a loose abrasive, but act like the teeth of a steel saw.

13,683 of 1906.—SIR W. G. ARMSTRONG, WHITWORTH, & CO., LTD., and F. G. D. JOHNSTON: *Valves for Hydraulic Hoists, and the like.*

This relates to a valve for use with hydraulic hoists and the like which is capable of being moved longitudinally and of being rocked by the flow of the water.

14,084 of 1906.—J. R. PEIRCE: *Machines for Countersinking Marble Slabs, and the like.*

This relates to a counter-sinking machine for marble or similar stone having a wheel of carborundum arranged to rotate at a high speed about a vertical axis, and to remove a shallow depth with its cylindrical face as the work is moved slowly in a plane transverse to the axis of the wheel, and having means for surrounding the cylindrical face of the wheel with water so as to avoid burning the work.

14,544 of 1906.—J. T. SHAW: *Draught-excluding Appliances for Doors.*

This relates to a draught-excluding appliance for doors comprising a rod or roller provided with flexible draught-excluding material such as leather, moleskin, or the like, angle brackets secured to said door to which said roller is pivoted or hinged a flat spring connected with said bracket, a projection on said roller or rod which is adapted to engage with the door frame and enter a recess in the door when closed, and means whereby the movement of said rod or roller is limited when the door is opened.

15,838 of 1906.—G. GUITTET: *Manufacture of Driers for Paints, Varnishes, and Oils.*

This relates to manufacture of a colourless drier for paints, varnishes, and the like, and consists in dissolving a salt or several salts of a metal or metals in alcohol acetone or acetone of amyl.

16,641 of 1906.—W. P. GIBBONS, R. MASTERS, and R. BAKER: *Ovens or Kilns for Annealing Iron Castings, for Burning Bricks and Pottery Ware, and for other similar uses.*

This relates to a circular oven or kiln for annealing iron castings, for burning bricks and pottery ware, and for other uses, having in the lower part of its wall a main annular surrounding gas flue connected with a gas-producer and made with branch upright flues opening into the upper part of the oven or kiln, which is provided with air passages in its outer walls leading from the outside and up at the sides of the branch gas flues, said oven or kiln having also a honeycomb floor made with passages and walls perforated to lead the waste heat in a tortuous manner to the main waste heat flue.

17,309 of 1906.—J. H. SMITH: *A Machine for Testing Materials of Construction under Alternating Stresses.*

This relates to a machine for testing materials under alternating stresses, consisting of elements in which a straight line component of the centrifugal force of a revolving mass is used to produce the alternations of stress in a specimen.

19,565 of 1906.—W. E. MORRIS: *Manufacture of Combined Box Ashpan and Dust Preventers for Domestic Firegrates.*

This relates to a combined box ashpan and dust preventer for domestic firegrates, in which the box ashpan part is made of two sheet metal blanks, one of which forms the bottom thereof, and the other forms the back and two sides of the same, these blanks being shaped and bent and secured together.

20,768 of 1906.—W. J. GIBSON: *Domestic Fireplaces.*

This relates to a domestic fireplace, and consists of transverse horizontal and vertical partitions so arranged beneath the grate that the rear part of the range is segregated from the front portion, and of devices for regulating the admission of air to the two compartments so formed.

22,127 of 1906.—K. BOTTCHER: *Windlasses for Hoisting and Discharging Grabs, Tip Buckets, and the like.*

This relates to a windlass for self-grippers or like vessels having two drums, one for the lifting or closing rope and one for the discharging rope, both the drums being driven by a single motor the shaft of which is arranged parallel with and between the shafts of the two drums, the arrangement permitting of either drum being driven by the shaft of the other drum, or by direct gearing with the motor.

22,291 of 1906.—W. IVES: *Fastenings for Window Sashes.*

This relates to a fastening device for window sashes, and consists of an arm pivoted to the lower sash in such a manner that when inoperative it is capable of being turned down to lie flush with the said lower sash.

26,721 of 1906.—M. F. BLANDFORD: *Non-slipping Tread Step.*

This relates to a non-slipping tread step, and consists in the combination with a filling proper of lead, or lead and antimony, cementitious material, or the like, of a material harder than the filling proper and embedded therein.

27,278 of 1906.—H. E. VEREY: *Means for Ventilating and Disinfecting Sanitary Dry Closets.*

This relates to a sanitary closet, and consists of a bowl, a trap hinged to the top thereof, a lid for said bowl, means connecting said lid and a trap, whereby the trap is opened when the lid is raised, and means for discharging a disinfectant into the bowl every time the lid is raised and lowered.

222 of 1907.—N. P. SJOBRING: *Sheet Metal Doors.*

This relates to a sheet metal door wherein the side stiles and end sections are made of parallel spaced plates whose side edges are connected to the inner edges of the side stiles by interlocking flanges forming an invisible seam, and consists in securing angle iron pieces on one or both sides of the panel within the end sections, and providing said angle iron pieces with right-angled flanges which bear outwardly edgewise against the undersides of the plates constituting the end sections, whereby the end sections are reinforced and braced from extensive pressure and are maintained in their relative positions.

954 of 1907.—E. W. KERNER: *Fence Posts.*

This relates to a fence post composed of metal and having a flat front face with thinned edges, and perforations at short intervals through the margins of the said thinned edges, said perforations extending from the top to the bottom of the post.

1,632 of 1907.—K. DIPPE: *Joints or Fastenings for Bars in Roof Openings.*

This relates to a joint or fastening for bars in roof openings comprising in combination with the wooden laths of the roof in which the cut-out part for the lighting hole is made, a strap placed above the cut-out part of said wooden laths, a base plate placed below the cut-out part of said wooden laths, pointed pins provided on said base plate and designed to compress themselves into the wood of said laths and thus to prevent said base plate from shifting, flanges provided on the ends both of said strap and said base plate, and screws screwed through said flanges and designed to fix said strap and said base plate firmly together.

1,636 of 1907.—J. O. OHLSSON: *A Method of Partially Impregnating Articles of Wood or Other Materials.*

This relates to a method of partially impregnating articles of wood or other material which are of a comparatively great length, the said articles being in their entirety or for a great extent surrounded by the impregnating matter which enters the articles transversely from their sides, and is characterised by the fact that the articles in those places where no impregnation or impregnation in a smaller degree has to be effected, are surrounded by or are coated in or on the surface with one or more substances of such a nature that the penetration of the impregnating matter at the said places is prevented or made difficult, or, if the articles are provided with a cover, partially or fully preventing the impregnating matter from entering by removing the said cover only at those places where impregnating is to be effected.

5,352 of 1907.—P. MULLER: *Locks.*

This relates to a safety lock having a key enclosed in the lock case and secured by tumblers, these tumblers being operable by an auxiliary key insertable into a separate keyhole.

5,945 of 1907.—G. EHLERT: *Doors.*

This relates to a door made of vertical planks, and is characterised in that the latter are provided with transverse holes through which the wooden joining ledges, together with a flat or cross-shaped iron are inserted in the whole width of the door.

10,091 of 1906.—B. E. ELDRED: *Process of and Apparatus for Making Cement Clinkers.*

This relates to a process for making cement clinkers in which the calcining operation and the clinkering operation are performed in separate kilns or chambers, and consists in the provision

PATENTS.—*Continued on page* 677.

* All these applications are in the stage in which opposition to the grant of Patents upon them can be made.

List of Competitions, Contracts, etc.

For some Contracts still open, but not included in this List, see previous issues. Those with an asterisk (*) are advertised in this Number: Competitions, iv.; Contracts, iv. vi. viii. x.; Public Appointments, xviii.; Auction Sales, xxx.

Certain conditions, beyond those given in the following information, are imposed in some cases, such as: the advertisers do not bind themselves to accept the lowest or any tender; that a fair wages clause shall be observed; that no allowance will be made for tenders; and that deposits are returned on receipt of a bonâ-fide tender unless stated to the contrary.

The date given at the commencement of each paragraph is the latest date when the tender, or the names of those willing to submit tenders, may be sent in.

***** It must be understood that the following paragraphs are printed as news, and not as advertisements: and that while every endeavour is made to ensure accuracy, we cannot be responsible for errors that *may* occur.**

Competitions.

JULY 2.—**Kilkenny.**—LIBRARY.—Kilkenny Corporation invite competitive designs, specification, and bill of quantities for the erection of a Carnegie free library. Cost of building not to exceed 1,800*l.* Designs to be sent to Mr. Edward O'Connell, Town Clerk, City Hall, Kilkenny.

Contracts.

BUILDING.

JUNE 1.—**Thirsk.**—GRAND STAND.—For erection of grand stand, to seat 200 people, in grounds of Thirsk Hall. Mr. J. T. Farndale, Barclay's Bank, Thirsk.

JUNE 3.—**Burnley.**—PALACE AND HIPPODROME.—Tenders are invited for the undermentioned works (preferable in one contract) required in the erection of the new palace and hippodrome proposed to be erected in St. James-street, Burnley:—Excavator, mason and bricklayer, carpenter and joiner, plumber and glazier, slater and plasterer, concretors. Application for bills of quantities, accompanied by a deposit of 1*l.* 1s., must be made to Messrs. Richard Horsfall & Son architects, Halifax, at their offices, 22A, Commercial-street, Halifax.

JUNE 3.—**Carlisle.**—LAUNDRY EXTENSION.—For builders', carpenters' and joiners', plumbers', plasterers', slaters', and painters' and glaziers' work required in extensions at the Carlisle Steam Laundry, Warwick-road, Carlisle. Names to the offices of Mr. Matthew Johnstone, architect and engineer, 22, Lowther-street, Carlisle.

JUNE 3.—**Drighlington, etc.**—ALTERATIONS.—The whole or any of the several trades, namely, bricklayer and mason, carpenter and joiner, plumber, plasterer, slater, and painter's work required in the proposed alterations to the "Valley Inn," Cockersdale, Drighlington; also to the "George Hotel," Holmforth, near Huddersfield, for Mr. Samuel Smith, of the Old Brewery, Tadcaster. Names to Messrs. Thomas Winn & Sons, architects, 84, Albion-street, Leeds.

JUNE 3.—**Exeter.**—FARMHOUSE ALTERATIONS.—Alterations and additions to Hoopern Farmhouse, Pennsylvania, Exeter. Plans and specifications may be seen at the offices of Messrs. Ellis, Son, & Bowden, F.S.I., surveyors and architects, Bedford-chambers, Exeter.

JUNE 3.—**Huddersfield.**—ALTERATIONS TO WORKS.—The masons' and bricklayers', plumbers' and glaziers', and concreters' works required in the erection of alterations to colour works, in Hillhouse-lane, Huddersfield. Plans may be seen, and quantities obtained, at offices of Messrs. P. Taylor & Co., architects, Central Buildings, Milnsbridge.

JUNE 3.—**North Shields.**—SCHOOL.—For proposed R.C. School, North Shields. Plans may be seen, and quantities obtained, from the architects, Messrs. Henry Gibson & P. J. Steinlet, on a deposit of 2*l.* 2s.

JUNE 3.—**Truro.**—RESIDENCE.—The erection of a residence at St. Clement, near Truro, for Mr. F. Wickett, according to plans and specifications, which may be seen at the offices of Mr. Leonard Winn, architect and surveyor, 27, Boscawen-street, Truro, and the Free Library-chambers, Redruth.

JUNE 4.—**Aberdeen.**—STEADING.—For the mason, carpenter, slater, and cement works of improvements on steading at Cothill, Grandhome, near Aberdeen. Plans and specifications may be seen with Messrs. Burnett & Reid, 12, Golden-square, Aberdeen.

JUNE 4.—**Accrington.**—BRUSHWORKS.—The erection of brushworks proposed to be built near "Penny House," for Mr. Walter Phillips. Application, by letter, to Mr. Henry Ross, architect, Cannon-street, Accrington.

JUNE 4.—**Ballycastle.**—COTTAGES.—Ballycastle R.D.C. invite tenders for building sixteen double labourers' cottages in blocks of two, and for fencing plots. Plans and specifications may be seen, and tender forms for the works can be obtained, from the Clerk to the R.D.C.

JUNE 4.—**Banchory Devenick Estate.**—ALTERATIONS ON STEADINGS.—For the mason, carpenter, and slater work of alterations on the steadings of Waterside and Hillside. Plans and specifications can be seen with Mr. Mutch, Forester's Cottage, Banchory Devenick.

JUNE 4.—**Brompton.**—WEAVING SHEDS.—The excavator, bricklayer and masons, carpenters and joiners, plumbers and glaziers, ironfounders, slaters, and painters' work required in the extension of weaving sheds, and alterations to existing buildings, at the Spinning Mills, Brompton, near Northallerton, for Messrs. W. and J. Pattison. Names to Messrs. Thomas Winn & Sons, architects and surveyors, 84, Albion-street, Leeds.

JUNE 4.—**Brynygwynon.**—COTTAGE.—Great Western Railway Directors invite tenders for the erection of a cottage at Brynygwynon level crossing, near Pencoed, South Wales. Plans and specification may be seen, and forms of tender obtained, at the office of the engineer at Newport Station.

JUNE 4.—**Gledholt.**—SUNDAY SCHOOLS, ETC.—For proposed new Sunday Schools, etc., Gledholt Wesleyan Methodist Church. Plans may be seen, and bills of quantities obtained, at offices of Mr. W. Cooper, F.R.I.B.A., architect, 4, Kirkgate-buildings, Huddersfield.

JUNE 4.—**Hathersage.**—WESLEYAN CHAPEL.—For the erection of Wesleyan Church and Schools at Hathersage. Apply to Messrs. Smith & Ensor, architects, 1, Hartshead, Sheffie'd.

JUNE 4.—**Rawtenstall.**—VILLA RESIDENCES.—Erection of two villa residences in Haslingdon New-road, Rawtenstall, for Mr. Richard Ashworth, J.P. Names to Mr. A. Brocklehurst, architect, St. James-chambers, Waterfoot.

JUNE 4.—**Scissett.**—RESIDENCE.—The erection of a detached residence in Cattlehurst-road, Scissett. Plans may be seen, and bills of quantities obtained, at office of Mr. J. Berry, architect and surveyor, 3, Market-place, Huddersfield.

JUNE 5.—**Christow.**—HOUSE.—Devon County Education Committee invite tenders for the erection of a teachers' house and for other work at the Christow Council School. The drawings, specification, and conditions of contract may be seen at the architect's office, 1, Richmond-road, Exeter.

JUNE 5.—**Langcot.**—HOUSES.—For the mason, carpenter, slater, plumber, plasterer, painter, and glazier works of dwelling-houses on the farm of Langcot, belonging to Mr. W. Matheson's Trustees. Plans and specifications may be seen with Mr. P. Fulton, architect, Forres.

JUNE 5.—**Newhills.**—ADDITIONS TO FARM OFFICES.—For mason, carpenter, and slater works of additions to farm offices, Denhead of Cloghill, Newhills. Plans and specifications will be seen with the tenant, and with Mr. William Ruxton, architect, 84, Union-street, Aberdeen.

JUNE 5.—**Whitby.**—CLOAK-ROOMS.—For the erection of new cloak-rooms to boys' and girls' departments at St. John's Schools, Whitby. The plans and specification may be seen at office of Mr. Edward H. Smales, A.R.I.B.A., architect, 5, Flowergate, Whitby, and bill of quantities may be obtained from him.

JUNE 6.—**Easter Bog o' Fearn, etc.**—ALTERATIONS.—The mason, carpenter, and slater works of:—(1) Alterations at Easter Bog o' Fearn; (2) alterations at Monimuies, Tiendland; and (3) alterations at Bauds, Kellas. The plans and specifications may be seen with Mr. John Wittet, architect.

JUNE 6.—**Milborne St. Andrew.**—SCHOOL ANNEX.—For building a school annex to the Wesleyan Chapel at Milborne St. Andrew. Plans and particulars may be seen on application to Mr. A. Chapman, Ivy Cottage, Fordington.

JUNE 6.—**Warrington.**—GREENHOUSE.—The Town Hall, Parks, and Baths Committee of the Council of the County Borough of Warrington invite tenders for the erection of a greenhouse in Bank Park, and also for the supply and fixing of a tank with a capacity of 1,000 gallons at the Baths, Legh-street. Drawing, specifications, etc., may be seen, and all further information obtained, at the office of the Borough Surveyor, Town Hall.

JUNE 7.—**Ecclefechan.**—ALTERATIONS TO POORHOUSE.—For alterations and improvements, including sanitary work, to Kirkpatrick-Fleming Combination Poorhouse, Ecclefechan. Names to Messrs. Oliver & Dodgshun, FF.R.I.B.A., architects, Carlisle. Plans, specifications, and all information for tendering may be obtained at the offices of the architects or upon application to the Governor at the Poorhouse.

JUNE 7.—**Glasgow.**—INFIRMARY RECONSTRUCTION.—Glasgow Royal Infirmary Managers invite tenders for C block (nurses' home), D block (power-house), and E block (laundry). Drawings may be seen at the office of the architect, Mr. James Miller, A.R.S.A., 15, Blythswood-square, Glasgow, from whom also copies of the schedules may be obtained on payment of 1*l.* 1s.

JUNE 7.—**Willington.**—HOUSE.—Willington U.D.C. invite tenders for the erection of cemetery attendant's house at Willington. Plans and specifications may be seen, and all particulars obtained, on making an appointment with the surveyor, Mr. J. H. Gardner, Oxford House, Willington, Durham.

JUNE 8.—**Crosby.**—HOUSES.—The erection of eight dwelling-houses at Crosby, in the County of Lincoln. Plans and specifications may be seen at office of Mr. W. H. Buttrick, P.A.S.I., architect, Scunthorpe.

JUNE 8.—**Greenodd.**—ALTERATIONS, ETC.—Alterations and additions are required to the outbuildings at Mount Pleasant, Greenodd. Plan and specification thereof can be seen on the premises, on application to the tenant, Mr. Prickett, from whom forms of tender can be obtained.

JUNE 8.—**Stainland.**—FIREPROOF MILL.—The erection of a fireproof mill, at Dog-lane Mills, Stainland, for Messrs. B. Taylor & Sons. Plans, etc., will lay for inspection, and quantities may be obtained, at offices of Messrs. Chas. F. Horsfall & Son, architects, Lord-street Chambers, Halifax.

JUNE 8.—**Treleathick.**—FARMHOUSE.—The erection of a farmhouse at Treleathick, in the Parish of St. Cleer, for Mr. W. N. Connock Marshall. The plans and specification can be seen at office of Mr. John Sansom, F.R.I.B.A., architect, Liskeard.

JUNE 9.—**Shotton.**—WASH-HOUSE.—For building wash-house, 5 yds. by 5 yds., with fireplace, with rustless boiler, to hold 16 gallons. Tenders to Secretary of Shotton Workmen's Club.

JUNE 10.—**Pentre.**—COUNTY COURT OFFICES.—The erection of County Court Offices at Pentre, Rhondda Valley. Plans and specification may be seen at office of Mr. W. D. Morgan, architect, Post-office, Chambers, Pentre.

JUNE 11.—**Isleworth.**—WORK AT GROSVENOR HOUSE.—Brentford Guardians invite tenders for the carrying out of certain work at Grosvenor House and Dundee House, Mill Plat, Isleworth. Plan and specification can be seen at offices of Mr. William Stephens, Clerk to the Guardians, Union Offices, Isleworth, W.

JUNE 11.—**Lesmahagow.**—SCHOOLS.—Lesmahagow School Board invite tenders:—(1) For mason, joiner, plumber, slater, plaster, and cement works of new school and house at Coalburn; (2) for mason, joiner, plumber, slater, and plaster works of a small addition to Kirkfieldbank School. Schedules of quantities may be had by applying to Mr. James N. Gilmore, Clerk, School Board Office, Lesmahagow, and by lodging a deposit of 1*l.* 1s.

JUNE 13.—**Monaghan.**—PIGGERIES.—Monaghan District Asylum Joint Committee invite tenders for the erection of piggeries, etc., according to plan and specification (prepared by Mr. Doran), which may be seen at the Board-room during office hours.

JUNE 13.—**Tonypandy.**—REBUILDING HOTEL.—For taking down and rebuilding the Cross Keys Hotel at Dunraven-street, Tonypandy, for Messrs. Crossweils' Cardiff Brewery Company, Ltd. Plans and specification may be seen, and bill of quantities and form of tender obtained, at the office of the architect, Mr. James T. Jenkins, architect and surveyor, Porth, Rhondda, on a deposit of 2*l.* 2s.

JUNE 14.—**Cheriton Fitzpaine.**—FARM BUILDINGS.—The erection of farm buildings at Stockaton Farm, Cheriton Fitzpaine. Plans, specification, etc., can be seen at the farmhouse by applying to Mr. Pearcey, the tenant.

JUNE 14.—**Crosby.**—SCHOOL.—Lindsey C.C. Education Committee invite tenders for the erection of an Elementary School at Crosby, near Scunthorpe. Bills of quantities and form of tender may be had on application to Messrs. Scorer & Gamble, architects, Bank-street-chambers, Lincoln, and on payment to them of 2*l.* 2s. The drawings and conditions of contract may be inspected at the offices of the architects.

JUNE 14.—**Llandaff.**—ROADS, ETC.—Tenders are invited for (*a*) new roads and sewers and (*b*) detached villa residence on the Llandaff House Estate, Llandaff. Plans and specifications to be seen at the office of the architect, Mr. W. H. D. Caple, 2, Church-street, Cardiff, and bills of quantities obtained on deposit of 1*l.* 1s.

JUNE 15.—**Lelant.**—RESIDENCE.—The erection of proposed residence for Miss Young at Lelant. Plans and specification may be seen by appointment at the office of Mr. Sampson Hill, architect, Green-lane, Redruth.

JUNE 15.—**Tonyrefail.**—HOUSES.—The erection of fifty-four or more semi-detached houses, together with the construction of roads, on the Rhiwgarn Estate, Tonyrefail, for Messrs. The Tonyrefail Building Club. Plans and specifications can be seen at the architect's office, 16, High-street, Tonyrefail.

JUNE 17.—**Whitehaven.**—SCHOOL.—Cumberland Education Committee invite tenders for the whole of the works required in the erection and completion of a new mixed Secondary School at Whitehaven, in accordance with plans and specifications prepared by Messrs. Grayson & Ould, architects, 31, James-street, Liverpool. Copies of bills of quantities can be obtained upon application at the architects' office, and will be sent on payment of 2*l.* 2s. Plans and specifications may be seen at the same address as well as at the Town Hall, Whitehaven.

JUNE 18.—**Leadgate and Washington.**—SCHOOLS.—Durham C.C. invite tenders for new Council Schools at Leadgate and Washington. Plans, etc., may be seen, and bills of quantities obtained, as follows:—For Leadgate School: At the office of Mr. G. T. Wilson, 21, Durham-road, Blackhill, R.S.O., county of Durham. For Washington School: At the office of Mr. J. W. Hanson, 79, King-street, South Shields.

JUNE 18.—**Nettlesworth, etc.**—SCHOOL WORKS.—The C.C. of Durham invite tenders for alterations at Nettlesworth, Ford, Fulwell, and Newbottle St. Matthew's Council Schools. Plans, etc., may be seen at the respective schools, or at the office of the County Education Committee's Architect, Shire Hall, Durham. Bills of quantities may be obtained from the Clerk to the Education Committee Shire Hall, Durham.

* JUNE 18.—**Swansea.**—OFFICES.—The Commissioners of H.M. Works, etc., invite tenders for erection of new County Court Offices at Swansea. For further particulars see advertisement in this issue.

JUNE 19.—**Porth.**—HOUSES.—Ten houses at Porth for Mrs. Packer, Alder-grove, Porth. Plans and

specification may be seen at office of Mr. James T. Jenkins, architect, Porth.

* JUNE 19.—**St. Helens.**—SCHOOL.—The St. Helens B.C. invite tenders for erection of new schools in College-street, St. Helens. For further particulars see advertisement in this issue.

* JUNE 25.—**Hill End.**—ASYLUM.—Tenders are invited for erection of additional works at the Hertfordshire C.C. Asylum, Hill End, near St. Albans. For further particulars see advertisement in this issue.

* JUNE 25.—**Ilford.**—LIBRARY AND HALL.—The Ilford U.D.C. invite tenders for the erection of a public library and hall, etc., situate at the junction of Kingswood-road and High-road, Seven Kings, Ilford, Essex. For further particulars refer to an advertisement in this issue.

* NO DATE.—**Alfriston.**—NEW SCHOOL.—The East Sussex Education Committee invite tenders for a new public elementary school at Alfriston. For further particulars refer to an advertisement in this issue.

NO DATE.—**Armagh.**—ALTERATIONS, ETC., TO HOUSE.—The execution of alterations and improvements to Greenpark House, Armagh, the residence of the Christian Brothers. Applications for plans and specification to be made to Mr. J. J. M'Donnell, architect, 27, Chichester-street, Belfast.

NO DATE.—**Carlisle.**—FARMHOUSE.—For proposed farmhouse, standing stone rigg, for Mr. E. Norman. Mr. H. Higginson, architect, 3, Lonsdale-street, Carlisle.

NO DATE.—**Cobridge.**—ALTERATIONS, ETC.—For alterations and additions to works at Cobridge for Messrs. Henry Alcock & Co., Ltd. Apply to Mr. H. Burgess, architect, Longton, and send a deposit of 2*l.* 2s. for bills of quantities.

NO DATE.—**Lochgelly.**—CEMETERY BUILDINGS, ETC.—Ballingry P.C., Lochgelly, Fifeshire, invite tenders for extension to cemetery, etc., at Ballingry. Application to be made to Mr. A. M'Gregor Mitchell, architect and surveyor, Coatbridge, for schedules of quantities, and plans may be seen in the office of the Clerk to the Council, Lochcraig, Lochgelly.

NO DATE.—**Radyr.**—RESIDENCE.—The erection of a residence at Radyr, near Cardiff. For plans and specification, apply 13, Ruthin-gardens, Cardiff.

NO DATE.—**Tallaght.**—HOUSE.—For rebuilding house, lately destroyed by fire, at St. Mary's Tallaght. Plans and specifications at office of Mr. W. A. Scott, architect, 45, Mountjoy-square, Dublin.

ENGINEERING, IRON, AND STEEL.

JUNE 3.—**Darlington.**—HEATING, ETC.—The Corporation invite tenders for heating and ventilating the Public Library. Plans and specifications may be seen, and bill of quantities obtained, at the offices of Mr. George Winter, Borough Surveyor and Waterworks Engineer, Town Hall, on depositing a cheque for 1*l.* 1s.

JUNE 3.—**Edinburgh.**—TRACK RAILS, ETC.—Edinburgh Corporation invite tenders for the supply and delivery of the following material:—Contract No. 1, track rails and fastenings; contract No. 2, slot rails and fastenings. The specifications, with forms of tender, general conditions, and drawings, can be obtained from the consulting engineer, Sir Alexander B. W. Kennedy, 17, Victoria-street, Westminster, London, S.W., on payment of a deposit of 2*l.* 2s. each. The specifications, general conditions, and drawings can be seen at, but not obtained from, the offices of the Burgh Engineer, Mr. James Massie, Police Chambers, Edinburgh.

JUNE 3.—**Glasgow.**—STEEL WORK FOR BRIDGE.—The Directors of the Caledonian Railway Company invite tenders for the works to be executed in the construction of the steel work required in the renewal of the superstructure of the underbridge, at ninety miles fifty-one chains west of Midcalder Station, on Edinburgh branch. Drawings may be seen at the office of the Company's District Engineer, Princes-street Station, Edinburgh, where copies of the specification and schedule may be obtained on payment of 2*l.* 2s.

JUNE 3.—**Southampton.**—WHARF FRONT.—The Southampton Harbour Board invite tenders for the construction of ferro-concrete wharf front, etc. (Hennebique system), at platform, Southampton. Plans and specifications to be seen on application to Mr. E. Cooper-Poole, A.M.Inst.C.E., Engineer to the Board, at the Harboard Offices, Town Quay. Bills of quantities may be obtained on payment of 2*l.* 2s.

JUNE 3.—**Taunton.**—BRIDGE WORKS.—Taunton T.C. invite tenders for the supply and erection of the steel trough flooring, etc., required for the reconstruction of Tangier Bridge (25 ft. span). Further particulars, including specification and plan, can be seen at the office of Mr. David Edwards, A.M.Inst.C.E., Borough Engineer, Municipal Buildings, Taunton.

JUNE 4.—**London.**—METALS, ETC.—Bombay, Baroda, and Central India Railway Company Directors invite tenders for the supply of:—(1) Metals; (2) galvanised strand wire for fencing. Tenders must be made on forms, copies of which, with specifications, can be obtained at offices of Mr. W. V. Constable, Secretary, Gloucester House, 2, 3, and 4, Bishopsgate-street Without, London, E.C., on payment of 21s. each (which will not be returned).

JUNE 4.—**London.**—RAIL CHAIRS.—Great Western Railway Directors invite tenders for the supply of about 5,000 tons of cast-iron rail chairs. Specification and forms of tender may be obtained on application to Mr. G. K. Mills, Secretary, Paddington Station, London.

JUNE 5.—**Baguley.**—BRIDGE.—Bucklow R.D.C. invite tenders for taking down Pickie Bridge, Shaylane, Baguley, and rebuilding a new bridge. Plans may be inspected, and copies of specifications obtained, at the Council's Sub-offices, Mossburn-buildings, Stamford New-road, Altrincham.

JUNE 5.—**Warminster.**—PLANT.—Warminster U.D.C. invite tenders for gas suction plant and gas engine, with shafting, etc. Specifications may be obtained, and drawings inspected, at the offices of Professor Henry Robinson, M.Inst.C.E., Parliament Mansions, Victoria-street, Westminster, S.W.

JUNE 7.—**Chesterfield.**—CAST-IRON TOWER.—The Chesterfield Gas and Water Board invite tenders for the manufacture and erection of a cast-iron outlet valve tower for a reservoir. Copies of specification and photo-prints may be obtained on payment of a deposit of 2*l.* at the offices of the Board, 24, Gluman-gate, Chesterfield, where a coloured copy of drawing may be also inspected.

JUNE 10.—**Chesterton.**—GASWORKS.—Wolstanton United U.D.C. invite tenders for a retort bench of seven arches, together with chimneys and accessories at the Gasworks, Chesterton. Copies of the drawings and specifications may be obtained from the Engineers, Messrs. Corbet, Woodall, & Son, Palace-chambers, Bridge-street, Westminster, S.W., upon payment of a deposit of 3*l.* 3s. (by cheque).

JUNE 10.—**Nottingham.**—VALVES, ETC.—Nottingham Water Committee invite tenders for the supply of valves and hydrants, pipes, lead, coal, taps, and fittings. Specifications and drawings, together with samples, weights, etc., may be seen, and other information obtained, at the office of the Water Engineer, Mr. F. W. Davies, St. Peter's Church-side, and forms of tender may be obtained at that office on payment of 1*l.* 1s.

JUNE 10.—**Worcester.**—BLACKMINSTER BRIDGE.—Worcestershire C.C. Highways and Bridges Committee invite tenders for the rebuilding in brickwork of Blackminster Bridge, near Evesham. Copies of the specification and drawings can be obtained of Mr. J. H. Garrett, Surveyor County Bridges, Shirehall, Worcester, on payment of 1*l.* 1s.

JUNE 11.—**London.**—GIRDER BRIDGES.—The Southern Mahratta Railway Company, Ltd., Board of Directors invite tenders for girder bridges, as per the specification and drawings, which may be seen at the offices of the Company, 46, Queen Anne's-gate, S.W. The charge for the specification is 1*l.* 1s.

JUNE 11.—**New Brighton.**—IRON PONTOON.—Wallasey U.D.C. invite tenders for the construction, etc., of one iron pontoon for New Brighton Ferry Landing Stage. Further particulars and specifications may be obtained at the Ferry Manager's Office, Seacombe Ferry, where drawings of the proposed pontoon may be inspected

JUNE 12.—**Salford.**—CAST-IRON PIPES.—Salford Corporation invite tenders for cast-iron pipes, mushroom valves, etc., in connexion with the roughing filters at the Sewage Works. The drawings, specified quantities, and form of tender may be obtained at the Borough Engineer's office, Town Hall, Salford, upon payment of 1*l.* 1s.

JUNE 13.—**Dublin.**—SWITCHBOARDS, ETC.—Dublin Lighting Committee invite tenders for the supply and erection of sub-station switchboards, transformers, and accessories. Specification, with general conditions and form of tender, can be obtained from the City Electrical Engineer, Fleet-street, Dublin, on payment of 1*l.* 1s. for each specification.

JUNE 17.—**Dublin.**—CAST-IRON CHAIRS.—Great Northern Railway Company (Ireland) Directors invite tenders for the supply of:—1,000 tons of 90-lb. steel bullhead rails, with the necessary fishplates, and 200 tons of cast-iron chairs. Specifications and forms of tender can be obtained from the Secretary on payment of 1s. each.

JUNE 17.—**South Shields.**—CONVENIENCES.—South Shields Corporation invite tenders for the construction of new conveniences, Laygate-circus. Drawings and specification may be seen, and bills of quantities obtained, at the office of Mr. S. E. Burgess, M.Inst.C.E., Borough Engineer and Surveyor, Chapter-row.

JUNE 18.—**Portsmouth.**—URINAL.—Portsmouth Corporation invite tenders for constructing, completing, and maintaining in thorough repair for six calendar months from the completion of the whole thereof, a six-stall urinal in Stamshaw-road, at the rear of the "Beresford" Public-house. The specification and plan may be seen, and a form of tender obtained, at the Borough Engineer's Office at the Town Hall.

JUNE 24.—**Dublin.**—BRIDGES.—The Great Northern Railway Company (Ireland) Directors invite tenders for the construction of bridges. Parties wishing to tender may see the drawings and specification at the office of Mr. W. H. Mills, Engineer-in-Chief, Amiens-street, Dublin, or copies of them at the District Engineer's office, Belfast, and can obtain at the said offices lithographed copies of the drawings, etc., upon payment.

JUNE 24.—**Kettering.**—HEATING.—The heating of Rothwell Parish Church by means of hot-water apparatus. Designs and specifications, together with prices of high-pressure or low-pressure systems, to be received by Mr. J. A. M. Morley, M.A., Vicar, the Vicarage, Rothwell, Kettering.

MISCELLANEOUS.

JUNE 3.—**Latchford.**—TERRA-COTTA.—Warrington Education Committee Sites and Buildings Committee invite tenders for supply and delivery of red terra-cotta dressings and arches for the new Bolton Council School, Latchford. The specification and drawings may be seen at the office of Messrs. J. E. Wright, Garnett, & Wright, architects, Sankey-street, Warrington.

JUNE 3.—**Orsett.**—CARTAGE.—Orsett R.D.C. invite tenders for the cartage of materials. A schedule showing approximately the quantities of material and distances to be carted, and form of agreement can be obtained, from the Highways Surveyor, Mr. F. T. Johnson, or at the Clerk's Office, 2, Orsett-road, Grays.

JUNE 4.—**Todmorden.**—FILTERING MEDIA.—Todmorden Corporation invite tenders for the supply and delivery of about 30,000 cubic yds. of filtering media required at the Sewage Disposal Works, Eastwood. Drawings and general conditions, etc., may be seen, and specifications and forms of tender obtained, on application to Mr. J. A. Heap, Borough Engineer, Town Hall, Todmorden.

* JUNE 5.—**West Ham.**—COAL AND COKE.—The County Borough of West Ham Council invite tenders for the supply of coal and coke to their Pumping Station, Abbey Mills; the Public Baths, Balaam-street; the Fever Hospital, Plaistow; and other departments within the Borough. For further particulars refer to an advertisement in this issue.

JUNE 6.—**Blaydon.**—SCAVENGING.—Blaydon U.D.C. invite tenders for the removal and disposal of scuttle ashes, contents of ashpits, house refuse, etc., at Blackhall Mill and New Chopwell. Specifications, form of tender, and full particulars may be obtained from Mr. Robert Biggins, Sanitary Inspector, at the Offices of the Council, Blaydon-on-Tyne.

JUNE 6.—**Harrow.**—DUST-CART, ETC.—Harrow U.D.C. invite tenders for the supply of one dust-cart, one horse sweeping-machine. Specifications and details to be supplied with each tender. (Mr. John Strachan, Clerk, Council Offices.)

JUNE 6.—**Kingston-upon-Thames.**—CARTING.—Kingston-upon-Thames Lighting Committee invite tenders for unloading such coal as may be brought for them to the landing-place near to the end of Down Hall-road, or to Kingston Railway Station, and for carting, delivering, stacking, and trimming the same at the Electric Works.

JUNE 7.—**Newport.**—LIGHTING.—Newport (Salop) U.D.C. invite tenders (A) for lighting, maintaining in repair, and providing oil and all necessary accessories for the installation of twenty-one Kitson lamps in this Urban District; (B) for supplying gas to the gas lamps in the district. All further information may be obtained from the Surveyor to the Council, at his office in Newport.

JUNE 12.—**Orsett.**—SCAVENGING.—The R.D.C. of Orsett invite tenders for the work of emptying cesspools, privies, earth closets, sanitary pails, etc., and removal of house refuse in the Parishes of West Thurrock and Stifford, for a period of twelve months, from June 24, 1907. Further particulars can be obtained of Mr. J. Hurst, 100, New-road, Grays, or of Mr. James Beck, Clerk to the Council, 2, Orsett-road, Grays.

JUNE 29.—**Southowram.**—CARTING.—The U.D.C. invite tenders for the carting of dross and granite. Mr. R. W. Evans, Commercial Bank-chambers, Halifax, Solicitor and Clerk to the Council.

JULY 31.—**Johannesburg.**—FIRE ESCAPE.—The Municipal Council of Johannesburg invite tenders for the supply of a self-propelled fire escape and a self-propelled tender. Specifications and forms of tender may be obtained on application to the Council's Agents in London Messrs. E. W. Carling & Co., St. Dunstan's-buildings, St. Dunstan's-hill.

NO DATE.—**Prestonpans.**—DRIVING STONE MINE.—Contractors wanted for driving stone mine, Prestongrange Colliery, Prestonpans. Particulars from Manager.

NO DATE.—**Shotts.**—DRIVING STONE MINE.—Offers wanted to drive stone mine in Shotts Iron Company's Calderhead Pit, Shotts, distance about 40 fathoms. Particulars at Colliery.

PAINTING, etc.

JUNE 3.—**Stockton.**—PAINTING.—Stockton Guardians invite tenders for certain painting work at the children's homes, and in Hartington and Windsor roads, Stockton-on-Tees, in two contracts. Specifications and forms of tender may be obtained at offices of Mr. Fred. Byers Watson, Clerk to the Guardians, Union Offices, Nelson-terrace, Stockton-on-Tees.

JUNE 4.—**Brighton.**—PAINTING.—Brighton Guardians invite tenders for painting the exterior of the Workhouse, Elm-grove. Forms of tender, copies of specification, and conditions of contract may be obtained at office of Mr. B. Burfield, Clerk to the Guardians, Parochial Offices, Princes-street, Brighton.

JUNE 4.—**Handforth.**—PAINTING, ETC.—Chorlton Guardians invite tenders for the painting, decorating, etc., required to be done at the Styal Cottage Homes, the adjacent farm buildings and cottages, and the house in the occupation of Mr. R. C. Eastwood, and the schools at Styal, Handforth, near Manchester. Specifications may be obtained upon application to the porter at the Union Offices.

JUNE 5.—**Bradford.**—PAINTING.—Bradford Corporation invite tenders for internal painting at the Kirkgate Market. Specification and form of tender may be obtained on application to the City Architect, Whitaker-buildings, Brewery-street, Bradford.

JUNE 5.—**Lichfield.**—PAINTING.—Lichfield Guardians invite tenders for painting and decorating required at their Infirmary and Observation Wards, Union Workhouse, Lichfield. Copies of the specification may be obtained, together with all necessary information, on application to Mr. R. J. Barnes, architect, City-chambers, Bore-street, Lichfield.

JUNE 6.—**Tooting.**—PAINTING.—Wandsworth Guardians invite tenders for (*a*) painting works at Tooting Home; (*b*) painting works at Infirmary. Forms of specification and tender can be obtained at offices of Mr. F. W. Piper, Clerk, Union Offices, St. John's-hill, S.W., upon payment of a deposit of 1*l.* for each set.

* JUNE 6.—**Wandsworth.**—PAINTING.—The Guardians of the Wandsworth Union invite tenders for (a) painting works at Tooting Home; (b) painting works at Infirmary. For further particulars refer to an advertisement in this issue.

JUNE 7.—**King's Norton, etc.**—PAINTING.—King's Norton and Northfield U.D.C. Education Committee invite tenders for the work of painting and decorating to be done in various schools during the midsummer vacation, July 26 to August 26, 1907. Forms of tender, together with specification and conditions of contract, may be obtained by sending a stamped foolscap envelope to the Secretary, Education Offices, King's Norton.

JUNE 13.—**London.**—PAINTING.—Kensington Board of Guardians invite tenders for painting a portion of the Infirmary, Marloes-road, Kensington. The specification and form of tender can be obtained at the office of the Guardians, Marloes-road, Kensington.

ROADS, SANITARY, AND WATER WORKS.

JUNE 3.—**Hebburn.**—ROAD WORKS.—The U.D.C. of Hebburn invite tenders for excavating, levelling, paving, channelling, etc. Plans, sections, and specifications may be seen at the surveyor's office, Argyle-street, Hebburn.

JUNE 4.—**Eston.**—ASPHALTING.—Tenders wanted, for 1,300 sq. yds. of asphalting, for the Eston and Normanby Burial Board. Specifications to be seen at the Board's Office at the cemetery. Mr. R. Franks, Clerk to the Board.

JUNE 4.—**Salford.**—SEWERING, ETC.—Salford Corporation invite tenders for the sewering, paving, and flagging of certain streets. Plans and specifications

may be seen, and forms of tender, with quantities, obtained, at the Borough Engineer's office, Town Hall, Salford.

JUNE 4.—**Whitchurch.**—STREET WORKS.—Llandaff and Dinas Powis R.D.C. invite tenders for private street improvement works in Coronation-road, Whitchurch, in accordance with specification, which may be seen, and bills of quantities obtained, on application to the surveyor, Mr. James Holden, A.M.Inst.C.E., Park House, 20, Park-place, Cardiff.

JUNE 5.—**Ashby.**—SEWERAGH WORKS.—The R.D.C. of Glanford Brigg invite tenders for works of sewage disposal to be carried out in Ashby. A plan and specifications may be seen, and forms of tender obtained, at the office of Mr. John Bainton, 3, Wells-street, Scunthorpe.

JUNE 5.—**Chulmleigh.**—WATER MAIN.—South Molton R.D.C. invite tenders for the extension of the water main in East-street, Chulmleigh, according to specifications prepared by Mr. W. S. Gardner, the Surveyor to the Council, and which are deposited for inspection at Mr. F. E. Lovell's, South Molton-street, Chulmleigh, and at the office of Mr. Fred. Day, Clerk to the R.D.C., South Molton.

JUNE 5.—**Smallthorne.**—ROAD WORKS.—The U.D.C. of Smallthorne invite tenders for metalling, paving, channelling, and making good south-street, Bradley, in accordance with plan and specification prepared by Mr. John William Deane, the Surveyor to the Council. The plan, specification, and form of contract may be inspected at the Council Offices.

JUNE 5.—**Whitchurch.**—DRAINS.—Glamorgan C.C. invite tenders for laying surface-water pipe drains and building catchpits along the Cardiff and Merthyr and the Velindre roads at Whitchurch. Plans and specification of the works required may be seen, and copies of the bill of quantities obtained, at offices of Mr. W. E. R. Allen, Deputy-Clerk of the County Council, Glamorgan C.C. Offices.

JUNE 6.—**Coupar Angus.**—FOOTWAYS, ETC.—The T.C. invites tenders for constructing (1) about 240 lin. yds. concrete kerb and channel, and the formation of macadamised footway at west side of Blairgowrie-road; as well as (2) the formation of about 190 sq. yds. concrete footway, with kerb and channel and paving repairs at other parts of the Burgh. Specifications and schedule of probable quantities and other information from the Burgh Surveyor, Mr. Robert Reid, architect, Blairgowrie.

JUNE 6.—**Edinburgh.**—PAVING, ETC.—Edinburgh Corporation invite estimates for paving works, etc. Schedules, specifications, and forms of tender may be obtained on application to the City Road Surveyor, City Chambers.

JUNE 6.—**Leeds.**—STREET WORKS.—Leeds Highways Committee invite tenders for the paving and flagging of the following streets:—Temple View-place, Balkan-grove, Raincliffe-road, Everleigh-road, Vinery-place, Vinery-view, Woodside-avenue, Highfield-road, and Aston-road. Drawings may be seen at the City Engineer's Office, Municipal Buildings. Forms of tender and bills of quantities may be obtained, and copies of the documents forming the contract inspected, on application at the Highways Office, 155, Kirstall-road.

JUNE 7.—**Worcester.**—CONCRETE SLAB PAVING.—Worcestershire C.C. Highways and Bridges Committee invite tenders for supplying and laying about 6,000 super. yds. of concrete slab paving. Specification and further particulars can be obtained on application to Mr. J. H. Garrett, County Road Surveyor, Shirehall, Worcester.

JUNE 8.—**Hoddesdon.**—PAVING.—Hertfordshire C.C. invite tenders for certain works of paving, kerbing, etc., to footpaths adjoining main roads in the town of Hoddesdon. A copy of the specification and schedule of works and a form of tender can be obtained at the County Surveyor's office upon payment of 1*l.* 1s.

JUNE 10.—**Dartmouth.**—WATER SUPPLY WORKS.—Dartmouth Corporation invite tenders for Contract No. 1.—The erection of a pumping station. Contract No. 2.—The construction of a covered service reservoir in masonry and concrete. Contract No. 3.—The construction of filters, storage reservoir, supply tanks, etc. Contract No. 4.—The supply of 2,000 yds. of 6-in. and 4-in. cast-iron mains, specials, valves, hydrants, and other ironwork. Contract No. 5.—The laying and jointing of the mains. Plans of the several works may be seen, and specifications and bills of quantities obtained (upon payment of 1*l.* 1s.), on application to Mr. Thos. W. Joyce, A.M.Inst.M.E., F.G.S., Borough Engineer's Office, Dartmouth.

✱ JUNE 10.—**Hendon.**—SEWERAGE, ETC.—The Hendon U.D.C. invite tenders for storm-water drainage, sewers, granite kerb, tar paving, Victoria stone paving, manholes, inspection chambers, gullies, etc., in connexion with the sewerage of Temple Fortune-lane and Granville-road, Child's Hill, N.W.; road widening and paving works, Golder's Green-road, Hendon, N.W.; and the fully making-up of Birkbeck-road, Mill Hill, N.W. For further particulars refer to an advertisement in this issue.

JUNE 10.—**Norley.**—WATER SUPPLY.—The R.D.C. of Runcorn invite tenders for the supply, delivery, and laying of about 1,200 yds. of 3-in. and 4-in. water mains, with valves and hydrants, in the Parish of Norley. Plans, specifications, etc., may be seen at the Offices of the Council, 71, High-street, Runcorn. Tenders must be made on forms, which, with copy of the specification, can be obtained at the said offices on payment of 1*l.* 1s.

JUNE 10.—**Stockton-on-Tees.**—PRIVATE STREET IMPROVEMENTS.—The Corporation invite tenders for private street improvement works. Plans and specifications may be seen, and quantities and forms of tender obtained, from Mr. M. H. Sykes, Borough Engineer, Town Hall, on payment of a deposit of 10s. 6d.

JUNE 11.—**Barnes.**—PAVING.—The U.D.C. of Barnes invite tenders for paving the carriage-way of Castelnau, Barnes, an area of about 20,000 sq. yds., with jarrah wood blocks, laid on a concrete foundation. Plan, sections, and specification can be seen, and copies of the schedule and form of tender obtained, on application to the Engineer and Surveyor, at the Council House.

✱ JUNE 11.—**Cricklewood.**—ROAD-MAKING.—The Willesden D.C. invite tenders for certain road-making and paving works in new road between Mora-road and Wotton-road, Cricklewood. For further particulars refer to an advertisement in this issue.

✱ JUNE 11.—**Kingston-on-Thames.**—NEW ROAD, ETC.—The Guardians of the Kingston Union invite tenders for new boundary wall and gates and the formation of a new road at Norbiton Common Farm, New Malden, and also for new oak fencing, dwarf wall, gates, etc., to replace existing fencing and gates to premises in London-road and Ellis-road, Kingston-on-Thames. For further particulars refer to an advertisement in this issue.

JUNE 11.—**Stow-on-the-Wold.**—LAVATORIES.—The Guardians invite tenders for the erection of lavatories, etc., and the redrainage of the Workhouse buildings. Plans and specifications may be seen at the Workhouse, or upon application to Messrs. Chatters & Smithson, architects, Regent-street, Cheltenham.

JUNE 11.—**Taff's Well.**—CEMETERY.—Caerphilly U.D.C. invite tenders for the construction of boundary walls, roads, and drainage, and other contingent works for the proposed cemetery at Taff's Well, near Cardiff. Drawings and specification may be seen, and forms of tender obtained, upon application to the Surveyor's Department, Council Offices, Caerphilly, upon depositing the sum of 1*l.* 1s.

✱ JUNE 11.—**Willesden.**—CONCRETE TUBES.—The Willesden D.C. invite tenders for 1,299 ft. lin. of 30-in. concrete tubes, together with saddle junctions, etc., to be supplied to the Recreation Ground, Stonebridge, Willesden, N.W. For further particulars refer to an advertisement in this issue.

✱ JUNE 11.—**Willesden.**—CONVENIENCE.—The Willesden D.C. invite tenders for supply and erection of an "above ground" convenience at Church End, Willesden. For further particulars refer to an advertisement in this issue.

✱ JUNE 11.—**Willesden.**—PAVING WORKS.—The Willesden D.C. invite tenders for certain paving works in passages at rear of houses in Walm-lane, Station-road, Grosvenor-gardens, Stanley-gardens, and Blenheim-gardens, Willesden Green, N.W. For further particulars refer to an advertisement in this issue.

JUNE 11.—**Wirral.**—SEWERS.—The R.D.C. of Wirral invite tenders for the partial reconstruction of old sewers and appurtenant works in the Township of Bidston. The drawings and specification may be seen at the office of the engineer, Mr. Frank E. Priest, M.Inst.C.E., 13, Harrington-street, Liverpool, from whom copies of the specification, forms of tender, and bill of quantities may be obtained on deposit of 2*l.* 2s.

JUNE 12.—**Bradford.**—PAVING, ETC.—The owners of Firth-street, Mary-street, and George-street, Thornton, Bradford, invite tenders for paving, flagging, kerbing, and other work. Bills of quantities may be obtained, and the specification and plans seen, at the City Surveyor's office, Town Hall, Bradford.

JUNE 12.—**Dunbar.**—LAYING PIPES.—Supplying and laying of water pipes, extending to about 2,266 lin. yds., of 4-in. iron pipes, according to specification and plan. Copies of specification and schedule may be had from Mr. Robt. White, Town Clerk, Town Clerk's Office, Dunbar, on payment of 1*l.* 1s.

JUNE 12.—**Larkhall.**—DRAINAGE.—The District Committee of the Middle Ward of the County of Lanark invite tenders for providing and laying about one and a half miles of outfall, intercepting, and other sewers from 9 in. to 18 in. in diameter. Plans may be seen, and copies of the specification and schedule of measurement obtained, at the office of Mr. W. L. Douglass, C.E., District Engineer, District Offices, Hamilton, on payment of 1*l.*

JUNE 12.—**Ryton.**—STREET WORKS.—The U.D.C. of Ryton invite tenders for the construction of street works at Grange-road, Ryton. Plans and specification may be seen, and quantities obtained, on application to Mr. John P. Dalton, Surveyor to the Council, Ryton, on payment of 10s.

JUNE 12.—**Shoreham.**—ROAD REPAIR.—Sevenoaks R.D.C. invite tenders for the repair of Eels-road, Shoreham. Specification may be obtained from Mr. R. Bailey, the Council's Surveyor, Sundridge, Sevenoaks.

JUNE 13.—**Hambledon.**—WATERWORKS.—Hambledon R.D.C. invite tenders for the drilling and tapping of mains, insertion of ferrules, and laying service pipes in the Parish of Haslemere. Form of tender, with schedules, can be obtained at the office of Mr. J. Howard, Lower-street, Haslemere.

JUNE 19.—**Oban.**—SEWERAGE WORKS.—The T.C. of Oban invite tenders for the construction and laying of a main intercepting and outfall sewer, etc. Plans and specification may be seen at the office of Messrs. D. & C. Stevenson, civil engineers, 84, George-street, Edinburgh, from whom schedules of quantities may be obtained on the payment of 1*l.* 1s.

JUNE 22.—**Waddington.**—SEWERAGE WORKS.—Bowland R.D.C. invite tenders for the laying of the pipes and other works of construction to complete the scheme of sewerage for the Township of Waddington. The plans and specification may be seen, and bills of quantities obtained, at the offices of Messrs. Simpson & Duckworth, engineers, Richmond-chambers, Blackburn, upon payment of a deposit of 2*l.* 2s.

JULY 4.—**Shenstone.**—SEWERAGE WORKS.—Lichfield R.D.C. invite tenders for the construction of sewerage and sewage disposal works at Shenstone. Drawings may be seen, and specification, etc., obtained, on application at the office of the Engineer, Mr. W. E. Rogers, Anson-street, Rugeley, on payment of 2*l.* 2s.

JULY 6.—**Delph.**—RESERVOIR.—Bolton Corporation Waterworks Committee invite tenders for the construction of a storage reservoir on the Delph Brook, situate in the township of Turton and county of Lancaster. An assistant engineer will meet intending contractors at Bolton station of the Lancashire and Yorkshire Railway at 11 a.m. on June 17 next. Plans may be seen, and copies of the specification, bill of quantities, and form of tender obtained, at the office of the Waterworks Engineer, Mr. R. H. Swindlehurst, M.Inst.C.E., Town Hall, Bolton, upon payment of 5*l.*

JULY 6.—**Delph.**—SLUICE VALVES, ETC.—Bolton Corporation Waterworks Committee invite tenders for providing and delivering sluice valves and for providing and erecting at the intended Delph Reservoir a cast-iron valve tower and standpipe. Specification, bill of quantities, and form of tender may be obtained at the office of the Waterworks Engineer, Mr. R. H. Swindlehurst, M.Inst.C.E., Town Hall, Bolton, upon payment of 1*l.*

JULY 15.—**Bath.**—PAVING.—The whole of the paving of the Corridor, Bath, about 144 ft. by 11½ ft., in sizes varying from 4½ ft. square to 3 ft. by 2½ ft. Apply for all particulars to Mr. Edmund Eames, Chairman, Corridor, Bath.

STONE, MATERIALS, AND STORES.

JUNE 3.—**Great Berkhampstead.**—PAVING MATERIAL.—The U.D.C. invite tenders for the immediate supply of about 600 yds. of approved non-slipping composite stone slab paving, 2 in. thick, delivered to Berkhampstead Station (L. and N.W. Railway). Any further particulars can be obtained from the surveyor.

JUNE 3.—**Hebburn.**—IRONWORK.—The U.D.C. of Hebburn invite tenders for the supply of ironwork during the ensuing twelve months. Form of tender may be obtained, and specimens of the ironwork required seen, at the surveyor's office, Argyle-street, Hebburn.

JUNE 3.—**Orsett.**—ROAD MATERIAL.—Orsett R.D.C. invite tenders for the supply of 800 tons 2-in. granite, 1,200 cubic yds. 2-in. quartzite, 950 yds. Kentish flints, and 700 cubic yds. 2½-in. Kentish ragstone. Forms of tender can be obtained from Mr. F. T. Johnson, Highway Surveyor, 2, Orsett-road, Grays.

JUNE 3.—**Winterton.**—GRANITE.—Winterton U.D.C. invite tenders, with samples, for a supply of 500 tons of granite; also tenders and samples for 200 tons of well-broken slag, and 50 tons of screenings; and also tenders for hauling the granite. Mr. A. Spencer, Clerk of the Council, Council Offices, Queen-street.

JUNE 4.—**Failsworth.**—MATERIALS.—The Failsworth U.D.C. invite tenders for the supply of materials and stores. Forms of tender and full particulars may be obtained at the office of Mr. G. F. Gray, Surveyor, Council Offices, Failsworth.

JUNE 4.—**St. Neots.**—ROAD MATERIAL.—St. Neots U.D.C. invite tenders for supply of and delivery to St. Neots Station, G.N. Railway, of about 1,000 tons broken granite and 150 tons ironstone slag. Particulars and forms of tender can be obtained on application to Mr. John Edey, Surveyor, South-street, St. Neots, Hunts.

JUNE 5.—**Kingston-upon-Thames.**—STORES.—Kingston-upon-Thames Corporation invite tenders for the supply, for the year ending June 30, of lime, cement, bricks, drain pipes, scavengers' brooms, oilmen's goods, ironmongery, etc. Forms of tender can be obtained at office of Mr. Harold A. Winser, Town Clerk, Municipal Offices, Kingston-upon-Thames.

JUNE 5.—**London.**—FIREWOOD.—The Guardians of the Poor of the Parish of St. Giles, Camberwell, invite tenders for the supply of 50 fathoms of best yellow deal and batten ends. Forms of tender, with further particulars, may be obtained upon application to Mr. Charles S. Stevens, Clerk to the Guardians, Guardians' Offices, 29, Peckham-road, S.E.

JUNE 5.—**London.**—GRANITE.—The Guardians of the Poor of the Parish of St. Giles, Camberwell, invite tenders for the supply of 100 yds. of granite spalls, to be delivered at their Workhouse, Gordon-road, Peckham. Forms of tender, with further particulars, may be obtained upon application to Mr. Charles S. Stevens, Clerk to the Guardians, Guardians' Offices, 29, Peckham-road, S.E.

JUNE 5.—**Manchester.**—DRAIN PIPES.—The Cleansing Committee of the Manchester Corporation invite tenders for twelve months' supply of agricultural drain pipes. Specifications may be obtained upon application to Mr. R. Williamson, Superintendent of the Cleansing Department, Town Hall, Manchester.

JUNE 5.—**Romney Marsh.**—ROAD MATERIAL.—Romney Marsh R.D.C. invite tenders for the supply and delivery of 400 yds. of quartzite or granite of 2-in. gauge. Mr. William B. Smith, District Surveyor, New Romney.

JUNE 6.—**Belfast.**—STORES.—Belfast Gas Committee invite tenders for stores. Schedule, with forms of tender, may be had on application at the Gas Works.

JUNE 6.—**Maldon.**—GRANITE.—Maldon T.C. invite tenders for 600 tons of 1½-in. granite and 500 yds. of flints. Forms of tender to be obtained of the Borough Surveyor, Mr. Thos. R. Swales, Council Offices, Maldon, Essex.

JUNE 8.—**Cardiff.**—STORES.—Cardiff Corporation invite tenders from Cardiff tradesmen for the supply of stores for the police and fire brigade departments for twelve months. Forms of tender may be obtained at the Head Constable's Office, Law Courts.

JUNE 8.—**Middlesbrough.**—STORES.—The Corporation of Middlesbrough invite tenders for the supply of stores. Specification and form of tender may be had on application to Mr. R. V. Thompson, jun., Stores Superintendent, 42, Commercial-street, Middlesbrough.

JUNE 8.—**Oswestry.**—STORES.—Cambrian Railways Company Directors invite tenders for supplies of stores. Specifications and forms of tender may be obtained at the Stores Office, Cambrian Works, Oswestry, and specimens.

JUNE 10.—**Clifton.**—GRANITE SETTS.—The Main Roads and Bridges Committee invite tenders for the taking-up and repaving of about 10,000 yds. of old granite setts on the Manchester and Bolton main road, in the Township of Clifton. Specification and form of tender may be had on application to the County Surveyor, Mr. W. H. Schofield, County Offices, Preston.

JUNE 10.—**Nottingham.**—VALVES, ETC.—Nottingham Water Committee invite tenders for the supply of valves and hydrants, pipes, lead, coal, taps, and fittings. Specifications and drawings, together with samples, weights, etc., may be seen, and other information obtained, at the office of the Water Engineer, Mr F. W. Davies, St. Peter's Church-side, and forms of tender may be obtained at that office on payment of 1*l.* 1s.

JUNE 10.—**Romford.**—ROAD MATERIAL.—Romford R.D.C. invite tenders for the supply of 400 tons of

best quality blue Guernsey granite and 200 tons of best quality blue Guernsey granite, also 550 tons of Rhenish basalt stone. Specification and form of tender may be obtained from Mr. George Lapwood, Highways Surveyor, Victoria-chambers, Romford.

* JUNE 12.—**Kingston-on-Thames.**—GRANITE.—Tenders are invited for the supply of 3,300 tons of Quenast, Guernsey, or other granite for road making. For further particulars see advertisement in this issue.

JUNE 13.—**Bristol.**—STORES.—Bristol Guardians invite tenders for the supply of articles. Forms to be obtained at office of Mr. J. J. Simpson, Clerk, St. Peter's Hospital, Bristol.

JUNE 13.—**London.**—STORES.—The Great Western Railway Directors invite tenders for the supply of stores. Specifications and forms of tender may be obtained on application to Mr. G. K. Mills, Secretary, Paddington Station, London, or to the Stores Superintendent at Swindon.

JUNE 15.—**Hoyland Nether.**—SUPPLIES.—Hoyland Nether U.D.C. invite tenders for the supply and delivery of road materials. Full particulars and form of tender may be obtained on application at office of Mr. H. G. Keywood, Surveyor, Town Hall, Hoyland, near Barnsley.

JUNE 19.—**Ormskirk.**—GOODS, ETC.—The Guardians of the Ormskirk Union invite tenders for the supply of goods and repairs at the Workhouse and Industrial Schools. Forms of tenders may be obtained on application at office of Mr. Alfred Dickinson, Clerk to the Guardians, Ormskirk, and any further information on application to the Master of the Workhouse.

JUNE 25.—**Scunthorpe.**—GRANITE.—Scunthorpe U.D.C. invite tenders for the supply of granite (1½-in. and 1¾-in. gauge), granite chippings (¾-in. and 1-in. gauge), slag (1½-in. and 2-in. gauge), and slag screenings. Particulars to be obtained from Mr. W. F. Bickford, Surveyor to the Council.

JULY 6.—**Delph.**—CAST-IRON PIPES.—Bolton Corporation Waterworks Committee invite tenders for providing and delivering 450 tons of cast-iron pipes and 50 tons of special castings. Specification, bill of quantities, and form of tender may be obtained at the office of the Waterworks Engineer, Mr. R. H. Swindlehurst, M.Inst.C.E., Town Hall, Bolton, upon payment of 1*l.*

Public Appointments.

Nature of Appointment.	By whom Advertised.	Salary.	Applications to be in
•TEACHERS OF ARCHITECTURE AND BUILD. CONSTRUCT.	Acton and Chiswick Polytec.	See advertisement in this issue	June 8
•TEACHER IN QUANTITY SURVEYING	Battersea Polytechnic	See advertisement in this issue	No date

Auction Sales.

Nature and Place of Sale.	By whom Offered.	Date of Sale.
•FREEHOLD PROPERTY, SLOANE-STREET, S.W.—At the Mart	M. Newton	June 5
•TIMBER, HAMPSTEAD-ROAD, N.W.—On the Premises	Joseph Hibbard & Sons	June 6, etc.
•BUILDING ESTATE, ST. LEONARDS-ON-SEA—At the Mart	Beagleys	June 12
•CONTRACTOR'S PLANT AND MACHINERY, MILLBANK, S.W.—On Land, Wood-st., S.W.	J. T. Skelding	do.
•CORNER BUILDING SITE, SOHO-SQUARE, W.—At the Mart	Garrett, White, & Poland	June 19
•FREEHOLD BUILDING SITE, CITY OF LONDON—At the Mart	David Burnett & Co.	do.
•CONTRACTOR'S PLANT AND MATERIAL, MAZE HILL AND CHARLTON—On the Premises	Fuller, Horsey, Sons, & Cassell	June 20
•FREEHOLD ESTATE, DARTFORD—At the Mart	Driver, Jonas, & Co.	June 24
FREEHOOLD BUILDING ESTATE, SOUTH CROYDON—At the Mart	Hampton & Sons	June 25
•FREEHOLD BUILDING SITES, HOLBORN—At the Mart	Debenham, Tewson, Richardson, & Co.	do.
•FREEHOLD BUILDING ESTATE, EDMONTON—At the Mart	David Burnett & Co.	June 28
•FREEHOLD SITE, CITY OF LONDON—At the Mart	Debenham, Tewson, Richardson, & Co.	July 2

PATENTS.—*Continued from page* 673.

of means for transferring the heat from the outgoing gases of either or each of said kilns or chambers to the incoming gases of the same kiln or chamber.

10,109 of 1906.—J. R. PEIRCE: *Machines for Moulding Marble and the like.*

This relates to a machine for moulding marble and the like, comprising in combination a roughing-out wheel of coarse carborundum or the like of about 16-mesh minimum size, and means for rotating it rapidly and feeding the block of marble to it slowly, the composition of the roughing wheel and the rates of rotation of feeding being such as to rough-out a moulding of substantial depth below the contiguous surface at a single feeding of the work through the machine.

14,404 of 1906.—H. MCGRAW: *Joints in Drain Pipes, and such like.*

This relates to pipes with spigot and socket joints in which the socket is fitted with internal ridges or projections and consists in the provision of points on said projections which may be easily fitted to provide for the variations in size and shape of different spigots.

17,400 of 1906.—H. HARRISON (C. DE LOS RICE): *Belt Gearing for Drill Presses and like Machines.*

This relates to a belt gearing for drill presses and like machines in which the driven spindle is not parallel to the driving-shaft, and is not in the same plane, and consists in providing idlers for the delivery and return sides of said belt, the return idler having a support adapted to swing in a horizontal plane to cause such idler to track with either of the driving pulleys.

17,541 of 1906.—F. HERBERT: *Machinery for Forming Moulds for Casting Metal Pipes.*

This consists in the provision of means for automatically locking and holding up the lower or socket pattern when it has been brought into its operating position and for automatically releasing it when it is to be withdrawn.

19,723 of 1906.—J. A. YATES: *Manufacture of Cement.*

This relates to a process of making cement, which consists in melting resin and mixing zinc oxide therewith, then continuing the application of heat until the mixture becomes a liquid, then adding marble flour thereto and finally allowing the mixture to cool.

21,160 of 1906.—H. SKINNER: *Mixing Machinery Applicable Especially for Mixing Slurry in the Manufacture of Cement.*

This relates to mixing machinery, and consists in the employment of a revolving vertical cylinder opened at its end, and for the most part but not completely immersed in the slurry, and having on the outside portions screw threads to prevent the slurry moving downwards, and on the inside screw threads to force the slurry upwards through the cylinder from the bell-mouthed upper end, of which it is drawn outwards to fall back into the bulk of the slurry at a distance from the cylinder.

TO CORRESPONDENTS.

NOTE.—The responsibility of signed articles, letters, and papers read at meetings rests, of course, with the authors.

We cannot undertake to return rejected communications; and the Editor cannot be responsible for drawings, photographs, manuscripts, or other documents, or for models or samples, sent to or left at this office, unless he has specially asked for them.

Letters or communications (beyond mere news items) which have been duplicated for other journals are NOT DESIRED

All communications must be authenticated by the name and address of the sender whether for publication or not. No notice can be taken of anonymous communications.

We are compelled to decline pointing out books and giving addresses.

Any commission to a contributor to write an article, or to execute or lend a drawing for publication, is given subject to the approval of the article or drawing, when received, by the Editor, who retains the right to reject it if unsatisfactory. The receipt by the author of a proof of an article in type does not necessarily imply its acceptance. The Editor cannot undertake to read and consider articles offered for acceptance unless they are type-written.

All communications regarding literary and artistic matters should be addressed to THE EDITOR; those relating to advertisements and other exclusively business matters should be addressed to THE PUBLISHER, and not to the Editor.

SOME RECENT SALES OF PROPERTY:

ESTATE EXCHANGE REPORT.

May 16.—By STEPHENSON & ALEXANDER (at Cardiff).

Glamorgan.—St. Bride's Major, an enclosure of freehold1 and 6 a, 2 r. 20 p.	£700
Southerondown, freehold building site, 1 a. 2 r. 0 p.	300

May 17.—By G. B. HILLIARD & SON (at Chelmsford).

Willingdoe, Essex.—"Dukes Farm," f., 143 a. 2 r. 34 p.	1,575
Hatfield Peverel.—"Haywoods," f., 35 a. 1 r. 26 p.	730
Cubitts Farm and Smiths Barn, f., 98½ acres	1,300
Ulting.—Three enclosures of freehold land, 13½ acres	363

May 22.—By PAYNE, TRAPPS, & CO.

Ealing.—113 and 115, Seaford-rd., u.t. 93 yrs., g.r. 9*l.*, w.r. 52*l.*	£360

By EDWARD WOOD.

Leytonstone.—68, Birkbeck-rd., f., e.r. 35*l.*	400

May 23.—By BISLEY & SONS.

Deptford.—45 and 47, Windmill-la., u.t. 38½ yrs., g.r. 6*l.*, e.r. 68*l.*	340
Bermondsey.—Marigold-st., plot of building land, f., 1,593 ft.	100

By H. J. BLISS & SONS.

Bethnal Green.—54 to 64, Three Colts-la., u.t. 25½ yrs., g.r. 21*l.*, w.r. 180*l.*	700
19 and 21, Wellington-row, u.t. 18 yrs., g.r. 10*l.* 10s., w.r. 75*l.* 8s.	180

By HAMPTON & SONS.

Sydenham.—"Melrose," u.t. 36¼ yrs., g.r. 13*l.* 14s. 6d., p.	525

By E. HUGH HENRY.

Clapham.—26, Liston-rd., u.t. 60 yrs., g.r. 7*l.*, y.r. 45*l.*	305
Battersea.—36, Hanbury-rd., u.t. 63 yrs., g.r. 4*l.*, w.r. 44*l.* 4s.	210

By STIMSON & SONS.

Shortlands, Kent.—Shortlands-rd., "Grove House," f.	1,000
Hackney.—25 to 43 (odd), Kenton-rd., u.t. 38 yrs., g.r. 40*l.*, w.r. 338*l.*	1,600
Long Acre.—Endell-st., f.g.r. 100*l.*, reversion in 47¼ yrs.	2,500
Hastings.—Carlisle-parade, etc., f.g.r. 22*l.* 10s., u.t. 41 yrs., g.r. 5*l.*	275
Trinity-st., f.g.r. 48*l.*, u.t. 41 yrs., g.r. 12*l.*	595
Beckenham.—Mossles-rd., f.g.r. 12*l.*, reversion in 60 yrs.	265
Victoria Park.—54, Robinson-rd., u.t. 46½ yrs., g.r. 1*l.* 15s., y.r. 35*l.*	340
Stratford.—90, Vicarage-la., u.t. 65 yrs., g.r. 4*l.*, y.r. 30*l.*	275

By J. A. & W. THARP.

Plaistow.—67, 69, and 71, Plaistow-rd., u.t. 43¾ yrs., g.r. 7*l.* 10., w.r. 74*l.* 2s.	295
Wanstead.—Cambridge-pk., "Fairfield," "Haddon," and "Burstead," f., y.r. 212*l.* 10s.	2,610
Leyton.—Lea Bridge-rd., freehold plot of land.	520

May 24.—By HAMPTON & SONS.

Bookham, Surrey.—The Little Bookham Estate, "Grape Vine Cottage," f., 2 a. 32 p.	460
The Little Bookham Estate, 38 acres building land, f.	2,250
The Little Bookham Estate, "Maddox Farm," f., 4 acres.	1,100
The Little Bookham Estate, 34 acres building land, f., p.	1,705
The Little Bookham Estate, building site, f., 5 a. 3 r. 4 p., p.	505
Effingham.—The Little Bookham Estate, building land, f., 9 a. 3 r. 35 p., p	700
Bookham.—The Little Bookham Estate, building land, f., 17 a. 1 r. 34 p., p.	1,210
The Little Bookham Estate, plot of building land, f., 2 acres, p.	250
The Little Bookham Estate, a meadow, f., 1 a. 0 r. 9 p., p	315

By STANLEY PARKES & BROWN.

Mile End.—60, Carlton-rd., u.t. 21¼ yrs., g.r. 3*l.* 5s., y.r. 26*l.*	170

By E. FERGUSSON TAYLOR.

New Barnet.—1, 2, and 3, Lytton-rd. (s.), f., y.r. 90*l.* 10s.	£1,270
Business premises, in rear of above, f.	570
1 and 2, Dawlish-villas, f., q.r. 38*l.*	409
1 and 2, Teignmouth-villas, f., q.r. 38*l.*	400
"Milton Villa," f., y.r. 22*l.*	255
"Leicester House," f., y.r. 65*l.*	1,100
Edmonton.—12, Eastbournia-av., f., q.r. 22*l.*	300
Holloway.—142 to 152 (even), George's-rd, f., w.r. 200*l.* 4s.	1,700
Dulwich.—159, Lordship-la., "The Victory" (off-licence), u.t. 61 yrs., g.r. 7*l.* 10s., y.r. 70*l.*	1,200
Walworth.—101, Villa-st., u.t. 44 yrs., g.r. 14*l.*, y.r. 65*l.*	500
New Barnet.—East Barnet-rd., f.g.r. 14*l.*, reversion in 72 yrs	380
East Ham.—Mountfield-rd., f.g.r. 81*l.*, reversion in 79 yrs	1,780
New Cross.—Pomeroy-st., f.g.r. 20*l.*, reversion in 29 yrs	545
Edmonton.—Granville-av., f.g.r. 40*l.*, reversion in 72 yrs	840
Town-rd., f.g. rents 107*l.* 16s., reversion in 72 yrs	2,625
Wood Green.—Victoria-rd., f.g. rents 26*l.* 10s., reversion in 94 yrs	661

By WALTER WINDRUM.

Poplar.—272, High-st. (s.), f., y.r. 32*l.* 10s.	300
City.—18, White Horse-alley, f., y.r. 29*l.* 2s. 4d.	550
Manchester-square.—47, Duke-st., f., y.r. 170*l.*	3,050
Kensington.—106, Kensington Palace-gdns., f., y.r. 75*l.*	1,100

Contractions used in these lists.—F.g.r. for freehold ground-rent; l.g.r. for leasehold ground-rent; l.g.r. for improved ground-rent; g.r. for ground-rent; r. for rent; f. for freehold; c. for copyhold; l. for leasehold, p. for possession; e.r. for estimated rental; w.r. for weekly rental; q.r. for quarterly rental; y.r. for yearly rental; u.t. for unexpired term; p.a. for per annum; yrs. for years; la. for lane; st. for street; rd. for road; sq. for square; pl. for place; ter. for terrace; cres. for crescent; av. for avenue; gdns. for gardens; yd. for yard; gr. for grove; b.h. beerhouse; p.h. for public-house; o. for office; s. for shops; ct. for court.

PUBLISHER'S NOTICES.

Nat. Tel., 6112 Gerrard. Telegrams, "The Builder, London.

CHARGES FOR ADVERTISEMENTS.

COMPETITIONS, CONTRACTS, ALL NOTICES ISSUED BY CORPORATE BODIES, COUNTY AND OTHER COUNCILS, PROSPECTUSES OF PUBLIC COMPANIES, SALES BY TENDER, LEGAL ANNOUNCEMENTS, etc., etc.

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Each additional line ..... 1s. 0d.

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Four lines (about thirty words) or under ..... 2s. 6d.
Each additional line (about ten words) ..... 0s. 6d.

PREPAYMENT IS ABSOLUTELY NECESSARY.

*** Stamps *must not* be sent, but all sums should be remitted by Postal Orders, payable to J. MORGAN, and addressed to the Publisher of "THE BUILDER," 4, Catherine Street, W.C.

Advertisements or the current week's issue are received up to HALF-PAST ONE p.m. on THURSDAY, but "Classification" is impossible in the case of any which may reach the Office after HALF-PAST TWELVE p.m. on that day. Those intended for the Outside Wrapper should be in by TWELVE NOON on WEDNESDAY.

ALTERATIONS IN STANDING ADVERTISEMENTS or ORDERS TO DISCONTINUE same must reach the Office before TEN o'clock on WEDNESDAY MORNING.

The Publisher cannot be responsible for DRAWINGS, TESTIMONIALS, etc., left at the Office in reply to advertisements, and strongly recommends that of the latter COPIES ONLY should be sent.

ADVERTISERS in "THE BUILDER" may have *Replies addressed to the Office*, 4, Catherine Street, Covent Garden, W.C., *free of charge*. Letters will be forwarded if addressed envelopes are sent, together with sufficient stamps to cover the postage. Unused stamps are returned to advertisers the week after publication.

N.B.—The Reply Boxes are not intended for trade lists, circulars, and the like; should these be received, they cannot (if noticed) be forwarded.

AN EDITION Printed on THIN PAPER, for FOREIGN and COLONIAL CIRCULATION, is issued every week.

READING CASES { NINEPENCE EACH. By post (carefully packed) 1s.

MEETINGS.

FRIDAY, MAY 31.

Royal Sanitary Institute.—Discussion on Infantile Mortality, at the Western Law Courts, Guildhall, Plymouth. 7.30 p.m.

SATURDAY, JUNE 1.

Architectural Association.—Third summer visit, to East Grinstead.

MONDAY, JUNE 3.

Society of Engineers.—Mr. Cecil A. St. George Moore, B.A. Camb., on "Working Experiences with Large Gas Engines." 7.30 p.m.

London County Council School of Building (Ferndale-road, Brixton, S.W.).—Four lectures on Building Methods in Nature's Workshop, by Mr. Alan E. Munby, M.A.—I. "The Earth's Early History." 8 p.m.

WEDNESDAY, JUNE 5.

Builders' Foremen and Clerks of Works' Institution.—Ordinary meeting of the members. 8 p.m.

THURSDAY, JUNE 6.

Royal Institution.—Professor Sir J. Dewar, M.A., on "Chemical Progress—Work of Mendeleeff and Moissan"—III. 3 p.m.

London County Council School of Building (Ferndale-road, Brixton).—Professor Beresford Pite on the Architecture of London (Ancient and Modern)—III. "The Renaissance Churches of London by Wren and his Successors." 7.30 p.m.

FRIDAY, JUNE 7.

Royal Institution.—Lecture by Professor Sir J. Dewar, M.A. 9 p.m.

SATURDAY, JUNE 8.

Junior Institution of Engineers.—Visit to the Works of Messrs. Kodak, Ltd. Harrow.

Edinburgh Architectural Association.—Visit to Parish Church, Bothwell Castle and Lennoxlove, Haddington.

PRICES CURRENT OF MATERIALS.

*** Our aim in this list is to give, as far as possible, the *average* prices of materials, not necessarily the lowest. Quality and quantity obviously affect prices—a fact which should be remembered by those who make use of this information.

BRICKS, &c.

	£ s. d.	
Hard Stocks	1 7 0	per 1000 alongside, in river.
Rough Stocks and Grizzles	1 6 0	" " "
Picked Stocks for Facings	2 10 0	" delivered.
Flettons	1 6 0	" at railway depôt.
Red Wire Cuts	1 14 0	" " "
Best Fareham Red	3 12 0	" " "
Best Red Pressed Ruabon Facing	5 0 0	" " "
Best Blue Pressed Staffordshire	3 15 0	" " "
Do. Bullnose	4 0 0	" " "
Best Stourbridge Fire Bricks	3 14 0	" " "
GLAZED BRICKS.		
Best White and Ivory Glazed Stretchers	12 0 0	" " "
Headers	11 0 0	" " "
Quoins, Bullnose, and Flats	16 0 0	" " "
Double Stretchers	19 0 0	" " "
Double Headers	16 0 0	" " "
One Side and two Ends	19 0 0	" " "
Two Sides and one End	20 0 0	" " "
Splays, Chamferred, Squints	20 0 0	" " "
Best Dipped Salt Glazed Stretchers, and Header	12 0 0	" " "
Quoins, Bullnose, and Flats	14 0 0	" " "
Double Stretchers	15 0 0	" " "
Double Headers	14 0 0	" " "
One Side and two Ends	15 0 0	" " "
Two Sides and one End	15 0 0	" " "
Splays, Chamferred, Squints	14 0 0	" " "
Second Quality White and Dipped Salt Glazed	2 0 0	" less than best.

	s. d.	
Thames and Pit Sand	7 0	per yard, delivered.
Thames Ballast	5 6	" "
Best Portland Cement	28 0	per ton, "
Best Ground Blue Lias Lime	19 0	" "

NOTE.—The cement or lime is exclusive of the ordinary charge for sacks.

Grey Stone Lime ..... 11s. 6d. per yard, delivered.
Stourbridge Fireclay in sacks 27s 0d. per ton at rly. dpt.

STONE.

	s. d.	
BATH STONE—delivered on road waggons, Paddington Depôt	1 6½	per ft. cube.
Do. do. delivered on road waggons, Nine Elms Depôt	1 8½	" "
PORTLAND STONE (20 ft. average)—Brown Whitbed, delivered on road waggons, Paddington Depôt, Nine Elms Depôt, or Pimlico Wharf	2 1	" "
White Basebed, delivered on road waggons, Paddington Depôt, Nine Elms Depôt, or Pimlico Wharf	2 2½	" "

	s. d.	
Ancaster in blocks	1 10	per ft. cube, deld. rly. depôt.
Beer "	1 6	" "
Greenshill "	1 10	" "
Darley Dale in blocks	2 4	" "
Red Corsehill "	2 2	" "
Closeburn Red Freestone	2 0	" "
Red Mansfield "	2 4	" "
YORK STONE—*Robin Hood Quality.*		
Scappled random blocks	2 10	" "
6 in. sawn two sides landings to sizes (under 40 ft. super.)	2 3	per ft. super., "
6 in. rubbed two sides ditto, ditto	2 6	" "
3 in. sawn two sides slabs (random sizes)	0 11½	" "
2 in. to 2½ in. sawn one side slabs (random sizes)	0 7½	" "
1½ in. to 2 in. ditto, ditto	0 6	" "
HARD YORK—		
Scappled random blocks	3 0	per ft. cube, "
6 in. sawn two sides landings to sizes (under 40 ft. super.)	2 8	per ft. super. "
6 in. rubbed two sides ditto	3 0	" "
3 in. sawn two sides slabs (random sizes)	1 2	" "
2 in. self-faced random flags	0 5	" "

SLATES.

In. In.	£ s. d.	
20×10 best blue Bangor	13 2 6	per 1000 of 1200 at r. d.
20×12 " "	13 17 6	" "
20×10 first quality "	13 0 0	" "
20×12 " "	13 15 0	" "
16×8 "	7 5 0	" "

SLATES (*continued*).

In. In.	£ s. d.	
20×10 best blue Portmadoc	12 12 6	per 1000 of 1200 at r. d.
16×8 " "	6 12 6	" "
20×10 best Eureka unfading green	15 17 6	" "
20×12 " "	18 7 6	" "
18×10 " "	13 5 0	" "
16×8 " "	10 5 0	" "
20×10 permanent green	11 12 6	" "
18×10 " "	9 12 6	" "
16×8 " "	6 12 6	" "

TILES.

	s. d.	
Best plain red roofing tiles	42 0	per 1000 at rly. depôt.
Hip and Valley tiles	3 7	per doz. "
Best Broseley tiles	50 0	per 1000 "
Do. Ornamental tiles	52 6	" "
Hip and Valley tiles	4 0	per doz. "
Best Ruabon red, brown, or brindled do. (Edwards)	57 6	" "
Do. Ornamental do.	60 0	" "
Hip tiles	4 0	per doz. "
Valley tiles	3 0	" "
Best Red or Mottled Staffordshire do. (Peakes)	51 9	per 1000 "
Do. Ornamental do.	54 6	" "
Hip tiles	4 1	per doz. "
Valley tiles	3 8	" "
Best "Rosemary" brand plain tiles	48 0	per 1000 "
Best Ornamental tiles	50 0	" "
Hip tiles	4 0	per doz. "
Valley tiles	3 8	" "
Best "Hartshill" brand plain tiles, sand-faced	50 0	per 1000 "
Do. pressed	47 6	" "
Do. Ornamental do.	50 0	" "
Hip tiles	4 0	per doz. "
Valley tiles	3 6	" "

WOOD.

BUILDING WOOD.	At per standard. £ s. d.	£ s. d.
Deals: best 3 in. by 11 in. and 4 in. by 9 in. and 11 in.	13 10 0	... 15 0 0
Deals: best 3 by 9	13 0 0	... 14 0 0
Battens: best 2½ in. by 7 in. and 8 in., and 3 in. by 7 in. and 8 in.	11 0 0	... 12 0 0
Battens: best 2½ by 6 and 3 by 6	0 10 0	less than 7 in. and 8 in.
Deals: seconds	1 0 0	less than best.
Battens: seconds	0 10 0	" "
2 in. by 4 in. and 2 in. by 6 in.	9 0 0	... 10 0 0
2 in. by 4½ in. and 2 in. by 5 in.	8 10 0	... 9 10 0
Foreign Sawn Boards—1 in. and 1¼ in. by 7 in.	0 10 0	more than battens.
¾ in.	1 0 0	"
	At per load of 50 ft.	
Fir timber: best middling Danzig or Memel (average specification)	4 10 0	... 5 0 6
Seconds	4 0 0	... 4 10 0
Small timber (8 in. to 10 in.)	3 12 6	... 3 15 0
Small timber (6 in. to 8 in.)	3 0 0	... 3 10 0
Swedish balks	2 10 0	... 3 0 0
Pitch-pine timber (30 ft. average)	4 0 0	... 4 15 0
JOINERS' WOOD.	At per standard.	
White Sea: first yellow deals, 3 in. by 11 in.	24 0 0	... 25 0 0
3 in. by 9 in.	22 0 0	... 23 0 0
Battens, 2½ in. and 3 in. by 7 in.	16 10 0	... 18 0 0
Second yellow deals, 3 in. by 1 in.	18 10 0	... 20 0 0
" " 3 in. by 9 in.	17 10 0	... 19 0 0
Battens, 2½ in. and 3 in. by 7 in.	13 10 0	... 14 10 0
Third yellow deals, 3 in. by 11 in. and 9 in.	13 10 0	... 15 0 0
Battens, 2½ in. and 3 in. by 7 in.	11 0 0	... 12 0 0
Petersburg first yellow deals, 3 in. by 11 in.	21 0 0	... 22 10 0
Do. 3 in. by 9 in.	18 0 0	... 19 10 0
Battens	13 10 0	... 15 0 0
Second yellow deals, 3 in. by 11 in.	16 0 0	... 17 0 0
Do. 3 in. by 9 in.	14 10 0	... 16 0 0
Battens	11 0 0	... 12 10 0
Third yellow deals, 3 in. by 11 in.	13 0 0	... 14 0 0
Do. 3 in. by 9 in.	12 10 0	... 14 0 0
Battens	10 0 0	... 11 0 0
White Sea and Petersburg—First white deals, 3 in. by 11 in.	14 10 0	... 15 10 0
" " 3 in. by 9 in.	13 10 0	... 14 10 0
Battens	11 0 0	... 12 0 0
Second white deals, 3 in. by 11 in.	13 10 0	... 14 10 0
" " 3 in. by 9 in.	12 10 0	... 13 10 0
" " battens	10 0 0	... 11 0 0
Pitch-pine: deals	18 0 0	... 21 0 0
Under 2 in. thick extra	0 10 0	... 1 0 0
Yellow Pine—First, regular sizes	44 0 0	upwards.
Oddments	32 0 0	"
Seconds, regular sizes	33 0 0	"
Yellow Pine oddments	28 0 0	"
Kauri Pine—Planks, per ft. cube	0 3 6	... 0 5 0
Danzig and Stettin Oak Logs—Large, per ft. cube	0 3 0	... 0 3 6
Small " "	0 2 6	... 0 2 9
Wainscot Oak Logs, per ft. cube	0 5 6	... 0 6 0
Dry Wainscot Oak, per ft. sup. as inch	0 0 8½	... 0 0 9½
¾ in. do. do	0 0 7	... —
Dry Mahogany—Honduras, Tabasco, per ft. super. as inch	0 0 9	... 0 1 0
Selected, Figury, per ft. super. as inch	0 1 6	... 0 2 6
Dry Walnut, American, per ft. super. as inch	0 0 10	... 0 1 0
Teak, per load	17 0 0	... 22 0 0
American Whitewood Planks, per ft. cube	0 4 0	... 0 5 0
Prepared Flooring, etc.—	Per square.	
1 in. by 7 in. yellow, planed and shot	0 13 6	... 0 17 6
1 in. by 7 in. yellow, planed and matched	0 14 0	... 0 18 0
1¼ in. by 7 in. yellow, planed and matched	0 16 0	... 1 0 0
1 in. by 7 in. white, planed and shot	0 12 0	... 0 14 6
1 in. by 7 in. white, planed and matched	0 12 6	... 0 15 0
1¼ in. by 7 in. white, planed and matched	0 15 0	... 0 16 6

WOOD (*continued*).

JOINERS' WOOD (*continued*)— Prepared Flooring, etc. (*continued*)—	Per square. £ s. d.		£ s. d.
¾ in. by 7 in. yellow, matched and beaded or V-jointed brds.	0 11 0	...	0 13 6
1 in. by 7 in. " "	0 14 0	...	0 18 0
¾ in. by 7 in. white " "	0 10 0	...	0 11 6
1 in. by 7 in. " " "	0 12 9	...	0 15 0

6 in. at 6d. to 9d. per square less than 7 in.

JOISTS, GIRDERS, &c.

	In London, or delivered Railway Vans, per ton. £ s. d.		£ s. d.
Rolled Steel Joists, ordinary sections	7 7 6	...	7 15 0
Compound Girders, ordinary sections	9 10 0	...	10 10 0
Steel Compound Stanchions	12 5 0	...	13 5 0
Angles, Tees, and Channels, ordinary sections	9 5 0	...	10 5 0
Flitch Plates	9 5 0	...	10 5 0
Cast Iron Columns and Stanchions including ordinary patterns	8 0 0	...	9 0 0

METALS.

	Per ton, in London. £ s. d.		£ s. d.
IRON—			
Common Bars	8 10 0	...	9 0 0
Staffordshire Crown Bars, good merchant quality	9 5 0	...	9 15 0
Staffordshire "Marked Bars"	11 0 0	...	—
Mild Steel Bars	9 10 0	...	9 15 0
Hoop Iron, basis price	9 15 0	...	10 0 0
" " Galvanised	17 10 0	...	—
("And upwards, according to size and gauge.)			
Sheet Iron Black—			
Ordinary sizes to 20 g.	10 0 0	...	—
" " 24 g.	11 0 0	...	—
" " 26 g.	12 10 0	...	—
Sheet Iron, Galvanised, flat, ordinary quality—			
Ordinary sizes, 6 ft. by 2 ft. to 3 ft. to 20 g.	16 0 0	...	—
Ordinary sizes to 22 g. and 24 g.	16 10 0	...	—
" " 26 g.	17 0 0	...	—
Sheet Iron, Galvanised, flat, best quality—			
Ordinary sizes to 20 g.	19 0 0	...	—
" " 22 g. and 24 g.	19 10 0	...	—
" " 26 g.	21 0 0	...	—
Galvanised Corrugated Sheets—			
Ordinary sizes 6 ft. to 8 ft. 20 g.	16 0 0	...	—
" " 22 g. and 24 g.	16 5 0	...	—
" " 26 g.	17 10 0	...	—
Best Soft Steel Sheets, 6 ft. by 2 ft. to 3 ft. by 20 g. and thicker	13 0 0	...	—
Best Soft Steel Sheets, 22 g. & 24 g.	14 0 0	...	—
" " 26 g.	16 0 0	...	—
Cut Nails, 3 in. to 6 in.	10 15 0	...	11 5 0

(Under 3 in., usual trade extras.)

LEAD, &c.

	Per ton, in London. £ s. d.		£ s. d.
LEAD—Sheet, English, 3lb. and up.	23 0 0	...	—
Pipe in coils	23 10 0	...	—
Soil pipe	25 10 0	...	—
Compo pipe	26 10 0	...	—
ZINC—Sheet—			
Vieille Montagne ...ton	33 5 0	...	—
Silesian	£3 0 0	...	—
COPPER—			
Strong Sheet ...per lb.	0 1 4	...	—
Thin " "	0 1 5	...	—
Copper nails "	0 1 3	...	—
BRASS—			
Strong Sheet "	0 1 2	...	—
Thin " "	0 1 3	...	—
TIN—English Ingots "	0 1 11	...	—
SOLDER—Plumbers' "	0 0 9	...	—
Tinmen's "	0 0 11	...	—
Blowpipe "	0 1 1	...	—

ENGLISH SHEET GLASS IN CRATES OF STOCK SIZES.

15 oz. thirds	2½d. per ft. delivered.
" fourths	1⅞d. " "
21 oz. thirds	3¼d. " "
" fourths	2⅝d. " "
26 oz. thirds	4¼d. " "
" fourths	3¼d. " "
32 oz. thirds	5d. " "
" fourths	4¼d. " "
Fluted Sheet, 15 oz.	3¼d. " "
" 21 oz.	4¼d. " "

ENGLISH ROLLED PLATE IN CRATES OF STOCK SIZES.

¼ Hartley's	2½d. per ft. delivered.
¼ "	2½d. " "
½ "	3d. " "
Figured and Oxford Rolled "Oceanic" Glass, white ...	4d. " "
Do. " tinted ...	5½d. " "

OILS, &c.

		£ s. d.
Raw Linseed Oil in pipes	per gallon	0 2 2
" " " in barrels	"	0 2 3
" " " in drums	"	0 2 5
Boiled " in pipes	"	0 2 4
" " " in barrels	"	0 2 5
" " " in drums	"	0 2 6
Turpentine in barrels	"	0 4 3
" in drums	"	0 4 7
Genuine Ground English White Lead	per ton	26 0 0
Red Lead, Dry	"	24 10 0
Best Linseed Oil Putty	per cwt.	0 7 0
Stockholm Tar	per barrel	1 12 0

VARNISHES, &c.

	Per gallon. £ s. d.
Fine Pale Oak Varnish	0 8 0
Pale Copal Oak	0 10 6
Superfine Pale Elastic Oak	0 12 6
Fine Extra Hard Church Oak	0 10 0
Superfine Hard-drying Oak, for seats of Churches	0 14 0
Fine Elastic Carriage	0 12 6
Superfine Pale Elastic Carriage	0 16 0
Fine Pale Maple	0 16 0
Finest Pale Durable Copal	0 18 0
Extra Pale French Oil	1 1 0
Eggshell Flatting Varnish	0 18 0
White Copal Enamel	1 4 0
Extra Pale Paper	0 12 0

VARNISHES, &c. (*continued*).

	Per gallon. £ s. d.
Best Japan Gold Size	0 10 6
Best Black Japan	0 16 0
Oak and Mahogany Stain	0 9 0
Brunswick Black	0 8 6
Berlin Black	0 16 0
Knotting	0 10 0
French and Brush Polish	0 10 0

TERMS OF SUBSCRIPTION.

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TENDERS.

Communications for insertion under this heading should be addressed to "The Editor," and must reach us *not later than* 10 *a.m. on Thursdays*. [N.B.—We cannot publish Tenders unless authenticated either by the architect or the building-owner; and we cannot publish announcements of Tenders accepted unless the amount of the Tender is stated, nor any list in which the lowest Tender is under 100*l.*, unless in some exceptional cases and for special reasons.]

*** Denotes *accepted*. † Denotes *provisionally accepted*.**

BLAKENEY.—For alterations and additions to Council school, for Gloucestershire Education Committee. Mr. R. S. Phillips, Architect, Shire Hall, Gloucester. Quantities by Messrs. Vale & Kingsford, St. Aldate-street, Gloucester:—

J. Coleman	£1,913 10 0	E. Precce	£1,720 0
J. Byard & Sons	1,850 0 0	W. F. Drew	1,690 0
J. Simmonds	1,830 0 0	E. Walters & Son	1,660 0
A. S. Cooke	1,825 4 6	Orchard & Peer	1,658 10
Saunders & Sons, Ltd.	1,790 15 6	H. Woolley & Son	1,635 0
W. Jones	1,725 0 0	T. Griffiths	1,626 10
Wall & Hook	1,725 0 0	Collins & Godfrey, Tewkesbury*	1,584 0

CARDIFF.—For the extension of the Infirmary, to form a new out-patients' department. Mr. Edwin Seward, F.R.I.B.A., Queen's-chambers, Cardiff:—

S. Shepton & Son	£10,130	Knox & Wells	£8,989
G. Couzins & Son	9,650	E. R. Evans & Bros.	8,895
F. Bond	9,600	F. Small	8,850
G. Hallett	9,500	D. W. Davies	8,772
W. Williams	9,500	J. Allan & Son	8,770
W. King & Son	9,226	W. Thomas & Co., Tresillian-terrace, Cardiff*	8,483
Gough Bros.	9,150		
G. Beames	9,030		
D. Davis & Son	8,990		

CHELTENHAM.—For repairs at the Workhouse, for the Guardians. Mr. T. Malvern, architect, 21, Winchcombe-street, Cheltenham:—

R. Pearce & Sons	£261 17 0	Eggleton & Co.	£182 17 6
Persey & Cornoch	223 15 9	G. Coates	166 0 0
H. J. Brown	209 0 0	J. Parslow, Victoria-street, Cheltenham*	165 12 6
E. Saunders & Sons	205 10 6		

COBHAM.—For the erection of two shops at Cobham, Surrey, for Mr. A. Smith. Messrs. Dartnell & Banks, architects, 34, High-street, Croydon:—

H. Bacon & Son	£997	F. Deacon & Son	£825
Cropley & Sons	987	E. B. Tucker	813
G. Kyle	860	S. Baldwin	790
H. Skilton	838	Gathercole Bros.	780

CONGLETON.—For erecting an Infectious Diseases Hospital at West Heath, for Congleton and District Joint Hospital Board. Messrs. Alfred Price & Son, architects, Elworth, Sandbach:—

Birchall Bros., Middlewich £6,820

DEVONPORT.—For erecting new ward block at the Infectious Diseases Hospital, near North Prospect, for the Corporation. Mr. J. F. Burns, Borough Surveyor, Municipal Offices, 29, Ker-street, Devonport. Quantities by Mr. S. W. Haughton, 22, Courtenay-street, Plymouth:—

W. G. Hoskin	£1,704 2 2	Matcham & Co.	£1,538 0 0
Pethick Bros.	1,697 10 0	W. E. Blake	1,516 0 0
H. J. Allen	1,696 11 9	F. J. Stanbury	1,501 17 0
J. Crockerill	1,683 14 0	A. N. Coles	1,491 2 6
Pearce Bros.	1,598 0 0	S. Roberts, Plymouth*	1,489 7 6
W. G. Perkins	1,581 10 6		

EBBW VALE.—For widening Libanus-road, etc., for the Urban District Council. Mr. T. J. Thomas, Town Surveyor:—

D. J. Vaughan, Tredegar £174 7 6

ELGIN.—For laying concrete foot pavements, for the Town Council. Mr. Acton A. Turriff, Burgh Surveyor, Elgin:—

J. Brodie	£196 19 10	A. Falconer	£155 5 11
G. Gray	164 12 6	A. Davidson & Son, Elgin*	153 12 11

FOOTSCRAY, Kent.—For erecting new Council school in the Longlands District, for the Kent Education Committee. Mr. Wilfrid R. Robinson, Architect and Surveyor to Committee. Quantities by Messrs. J. Leaning & Sons, John-street, W.C.:—

H. G. Lane	£5,850	T. Knight	£4,200
Loasby & Salmon	5,050	T. Crossley & Son	4,170
W. Parmenter	4,815	G. E. Everitt	4,145
F. & G. Foster	4,566	G. H. Gunning & Sons	4,135
S. Page & Son	4,548	J. Davison	4,122
F. Webster & Son	4,425	L. Seager	4,104
J. Lonsdale	4,394	J. Parsons	4,077
J. H. Lowe	4,383	W. H. Hyde & Co.	4,063
S. E. Moss & Co.	4,365	G. E. Wallis & Sons, Ltd.	4,038
J. Podger & Sons	4,350	R. Cook & Sons	3,965
A. E. Tong	4,325	C. E. Skinner, Chatham*	3,822
T. D. Leng	4,324		
J. D. Andrews	4,300		
W. Pollock	4,250		
W. F. Blay	4,217		

HARPENDEN.—For new kerbing at Harpenden, for the Hertfordshire County Council. Mr. Urban A. Smith, County Surveyor, Hatford:—

E. McEntee	£184 5 0	W. Griffiths & Co., Ltd.	£130 7 6
C. W. Killingback & Co.	174 0 0	T. Free & Sons	124 11 2
Neave & Nairn	170 0 0	G. Powdrill, Luton*	117 17 10
G. Porter	161 9 2		
H. Williams	133 6 6		

HODDESDON.—For making up of a private street (Briscoe-road) for the Urban District Council. Mr. W. H. Flood, Surveyor, High-street, Hoddeston:—

—	Road. £ s. d.	Drain. £ s. d.	Total. £ s. d.
G. Impey	—	68 11 0	—
S. Redhouse	850 16 6	58 13 0	909 9 6
C. Cuffley	805 10 9	85 13 9	891 4 6
G. Rose	791 7 2½	81 18 11	873 6 1½
H. Soan	757 6 1	78 8 3	835 14 4
R. Randall	739 9 2	60 3 0	799 12 2
Wallace & Inns	704 0 0	43 7 0	747 7 0
U. Swaker	674 11 9	59 8 0	733 19 9
H. Brazier	672 17 7	52 4 0	725 1 7
G. Bell	635 0 0	69 0 0	704 0 0
Griffiths & Co.	629 19 10	60 14 0	690 13 10
Free & Sons	596 19 4	71 6 4	668 5 8
E. McEntee	606 19 0	50 17 0	657 16 0
Pearson, Wilson, & Co.	606 8 8	47 12 0	654 0 8
E. T. Bloomfield	576 0 0	75 0 0	651 0 0
Trueman, Ltd.	598 18 10	49 6 6	648 5 4
Rogers & Wood	585 16 6	50 12 0	636 8 6
F. G. Porter	559 19 8	61 3 0	621 2 8
H. Williams	532 10 3	67 14 0	600 4 3
G. Porter	543 2 2	54 9 0	597 11 2
P. Tofts	542 11 6	53 9 8	596 1 2
J. Jackson, Forest Gate, E.*	539 15 6	41 17 0	586 12 0
Surveyor's Estimate	574 19 8	60 2 0	635 1 8

LITTLEBOROUGH.—For erecting 170 lineal yds. of river wall at sewage works, for the Urban District Council. Mr. G. H. Wild, Surveyor to the Council:—

Dryland & Preston, Littleborough.. Schedule of Prices.

LONDON.—For alterations at St. Clement's Parish Hall, Fulham Palace-road, S.W. Messrs. Monson & Sons, F.R.I.B.A., architects, Acton-vale, W., and at 22, Buckingham-street, Adelphi, W.C.:—

Adamson & Sons	£3,366	Bulled & Co.	£2,491
Patman & Fotheringham	2,821	W. Blackburn	2,300
C. Johnson	2,665	Godson & Sons	2,300
J. Christie	2,649	Southern Building Co.	2,175
J. Howell	2,620	J. Simms, Fulham, S.W.*	1,983
Bendon, Ltd.	2,505		

LONDON.—For alterations and erecting new billiard saloon at the Freemasons' Tavern, Victoria Dock-road, Custom House, E., for Miss M. C. Osborne. Mr. J. M. H. Gladwell, architect, Essex House, High-street, Stratford, E. Quantities by Mr. W. T. W. Castell, 31, Great St. Helens, E.C.:—

Harris & Wardrob	£1,637	Sheffield Bros.	£1,464
A. E. Symes	1,595	W. J. Maddison	1,458
Stedman & Co.	1,565		

LONDON.—For additions, Field-road U.M.F. Church, Forest Gate, E. Messrs. G. Baines & Son, architects, 5, Clement's-inn, Strand, W.C.:—

E. W. Wordley	£1,465 8 10	Sands & Burley	£1,230 0 0
H. J. Carter	1,438 0 0	Battley, Sons, & Holness*	1,192 0 0
C. Heath	1,386 0 0		
G. J. Hosking	1,329 0 0		

LONDON.—For additions to the call-over office at the Guardians' Offices, Brook-street, Kennington, S.E., for Lambeth Guardians. Mr. S. R. J. Smith, architect, 8, Duke-street, Adelphi:—

F. Deacon & Son, Addlestone, Surrey, W.C.* .. £135

[Tender revised.]

LONDON.—For decoration and repairs, Victoria Chapel (U.M.F. Church), Westminster, S.W. Messrs. George Baines & Son, architects, 5, Clement's-inn, Strand, W.C.:—

R. Clarke	£429 10	Battley, Son, & Holness	£383 10
Sands & Burley	339 10	J. Roberts*	343 10

Heating.

Wontner, Smith, Gray, & Co.* £98 15

MERTHYR VALE.—For erecting a chapel, for the Methodist Connexion. Mr. W. Dowdeswell, architect, Treharris:—

J. Thomas	£2,030 0	Jones Bros.	£1,885
E. Evans	1,950 0	J. Lloyd	1,800
W. S. Pratt	1,888 10		

MISTLEY.—For laying 265 yds. of 9-in. sewer in Gravel-lane, for Tendring Rural District Council. Mr. H. H. Parker, Surveyor, Dovercourt:—

J. G. Porter, Moorgate-street, London* .. £206

NEWLYN.—For harbour improvement works, for Newlyn Pier and Harbour Commissioners. Mr. W. T. Douglass, engineer, 15, Victoria-street, Westminster, S.W.

Knights, Hyland, & Co.	£25,521 14 10
Tilbury Constructing and Dredging Company	24,392 15 10
F. Bevis	21,245 6 5
Playfair & Toole	22,170 4 8
Batcham & Co., Ltd.	19,756 10 4
Hobrough & Co.	18,430 7 1
J. Riley	18,186 14 0
E. R. Lester	18,147 0 0
A. N. Cole	17,005 18 7
A. Carkeek	15,989 0 0
A. Fasey & Son	15,310 2 10
R. H. B. Neal, Ltd., Plymouth*	14,924 17 4
E. H. Page	14,440 0 7
R. C. Brebner & Co.	13,369 0 0

[Engineer's estimate, £14,700.]

NANTWICH.—For erecting chapel and schools in Broad-lane, for the Primitive Methodist Trustees. Mr. R. Matthews, architect, Parr's Bank-chambers, Nantwich:—

Huxley	£525	Cox & Vaughan	£410
Gresty	494	Harding	405
Manley	487	Matthews	384
Lawton & Chesters	468	Platt Bros.	375
Healey	427	Read, Nantwich*	372

OYSTERMOUTH (Swansea).—For executing private street works, Victoria-avenue, Oystermouth, for the Urban District Council. Quantities by Surveyor:—

J. H. Bevan	£211 1 3	J. G. Morris	
T. Walker	200 5 0	Oystermouth*	£159 19 6
Bennett Bros.	181 18 1		

POCKLINGTON.—For erecting a Council school to accommodate 250 children, for the East Riding of Yorkshire County Council Education Committee. Mr. B. B. Stamford, building surveyor, Beverley. Quantities by Mr. J. Watson, Cogan-chambers, Hull:—

T. C. Grant, Pocklington* £2,512

PORTHCAWL (Glam.).—For the erection of a new Council school at Porthcawl, for the Glamorgan Education Committee. Mr. D. Pugh-Jones, County Architect (Eastern Division), Cardiff:—

S. Shail, Llandaff £3,158 10 8

[Estimate, £3,150.]

RADCLIFFE.—For erecting a Wesleyan Church. Mr. W. Burton, architect, 69, Queen-street, Oundle:—

Gordon Bros., Stakeford, Choppington* £594 10

[This price does not include the cost of bricks.]

ST. AGNES (Cornwall).—For nearly two miles of cast-iron water main and 2 in. diameter, etc. (water supply to Wheal Rose), for Truro Rural District Council:—

R. & J. Hooper, Wynberg, St. Agnes, Scorrier* £449 1 6

SHAVINGTON-CUM-GRESTY.—For waterworks (Contract No. 2), for Nantwich Rural District Council. Mr. J. A. Davenport, C.E., 152, Hospital-street, Nantwich:—

W. P. Meikle	£204 1 6	J. E. Hughes	£137 2
T. W. Rigby	179 5 6	C. J. Nevitt, Ltd.	93 13
J. Johnson	177 0 6	J. Peake & Son, Willaston*	78 10
R. C. Brebner & Co.	159 8 0		
G. H. York & Co.	138 9 0		

SHAVINGTON-CUM-GRESTY.—For waterworks, (Contract No. 1), for Nantwich Rural District Council. Mr. J. A. Davenport, C.E., 152, Hospital-street, Nantwich:—

Iron Pipes.

	Per ton.
J. E. Hughes	£6 12 6
C. J. Nevitt, Ltd.	5 17 0
Holwell Iron Co., Ltd.	5 16 6
Sheepbridge Coal and Iron Co.	5 12 6
Clay Cross Co.	5 15 10
Cochrane & Co., Dudley*	5 11 6

Fittings.

Glenfield & Kennedy, Kilmarnock* .. £7 6 9

[Nine competitors.]

SUTTON (Surrey).—For cleaning and painting work at the Downs School, Banstead-road, for the Metropolitan Asylums Board. Mr. W. T. Hatch, Engineer-in-chief:—

A. Jones & Co.	£2,246 0 0
J. J. Richards	1,561 19 0
Southern Building Co., Ltd.	1,219 0 0
F. Kinnaird	1,039 7 8½
Vigor & Co.	989 0 0
W. J. Simms & Sons	982 0 0
J. & M. Patrick	959 0 0
Wontner & Co., Ltd.	887 0 0
E. Proctor & Son	834 9 2
M. McCarthy	768 0 0
D. T. Bostel & Sons	735 0 0
P. McCarthy	699 0 0
W. Hussey, 32, Albert Hall-mansions, Kensington*	690 0 0

TOW LAW.—For sewerage works for the Urban District Council. Mr. J. Hillary, Surveyor, Tow Law. Quantities by Mr. J. H. Mole, Chester-le-Street:—

W. Walton	£995 10 0	Johnson & Strong	£798 15 1
J. W. White	991 0 0	J. Robson	776 5 6
W. Lisker	950 0 0	Walton Bros.	775 0 0
G. Thornton & Co.	925 7 6	Mrs. M. D. Ayton, Tow Law*	698 15 0
J. Carrick	812 0 0		

TOOTING.—For erecting a hall at the Tooting Home, Church-lane, for the Wandsworth Guardians. Mr. Cecil A. Sharp, A.R.I.B.A., 11, Old Queen-street, Queen Anne's-gate, S.W. Quantities by Mr. B. Swinstead, Wellington-street, Strand:—

R. A. Jewell	£3,116	Cropley Bros.	£2,847
Page & Co.	3,050	E. B. Tucker	2,828
J. W. Hallett	3,049	F. Eaton	2,828
Martin, Wells, & Co.	2,995	E. Streather	2,804
Higgs & Hill	2,984	L. F. Lamplough	2,781
Myall & Upson	2,980	A. Leather	2,772
Patman & Fotheringham	2,973	H. G. Foster	2,762
J. & W. Drake	2,967	Johnson & Co.	2,760
F. G. Minter	2,963	Wallis & Sons	2,734
Chadwell-heath Joinery Co.	2,950	Moss & Co.	2,725
J. Smith & Son	2,945	Cook & Sons	2,712
W. Lawrence & Son	2,944	Garrett & Son	2,696
E. Lawrance & Sons	2,940	J. Barker & Co., Ltd.	2,687
T. Holloway	2,869	Spencer Santo, Ltd.	2,685
F. & H. F. Higgs	2,859	Pasterfield & English	2,599
B. E. Nightingale	2,859	E. Wall	2,590
H. H. Hollingsworth	2,849	Hyde & Co.	2,579
Courtney & Fairbairn	2,847	Fitch & Cox, Enfield*	2,514

UPPER WARLINGHAM.—For detached residence, Upper Warlingham, Surrey, for Mr. G. E. Williams. Messrs. Dartnell & Banks, architects, 34, High-street, Croydon:—

G. Cheeseman	£1,480	Truett & Steel	£1,105
H. Bacon & Son	1,393	J. Quittenton	1,095
Gathercole Bros.	1,200	S. Baldwin	1,046
J. Horrocks	1,195		

WALTHAMSTOW.—For additions and alterations to engine-house at Walthamstow, for the Metropolitan Water Board:—

Abbott, Heinrich, & Co.	£959 10 7	Mattock Bros.	£847 0 0
T. Almond & Son	895 0 0	Fitch & Cox, Enfield*	799 0 0
		Hyde & Co.	751 0 0

WELLINGTON.—For glazed pipe sewer, 900 yds. in length, for the Urban District Council. Mr. E. T. Howard, Surveyor:—

Follett Bros.		J. Twyford, Wellington*	£327 0
Sweet & Burge	£330 10		

[Sewage scheme schedule prices would come to about £340.]

WEST HORSLEY.—For erection of detached residence at West Horsley, Surrey, for Mr. A. Crouch. Messrs. Dartnell & Banks, architects, 34, High-street, Croydon:—

E. B. Tucker	£1,119	G. Everitt	£994
G. Cummins & Sons	1,075	R. Bacon & Son	989
H. Skilton	998	Gathercole Bros.	980
Truett & Steel	995		

J. J. ETRIDGE, Jr.

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Asphalte.—The Seyssel and Metallic Lava Asphalte Company (Mr. H. Glenn), Office, 42, Poultry, E.C.—The best and cheapest materials for damp courses, railway arches, warehouse floors, flat roofs, stables, cow-sheds and milk-rooms, granaries, tun-rooms, and terraces. Asphalte Contractors to the Forth Bridge Co.

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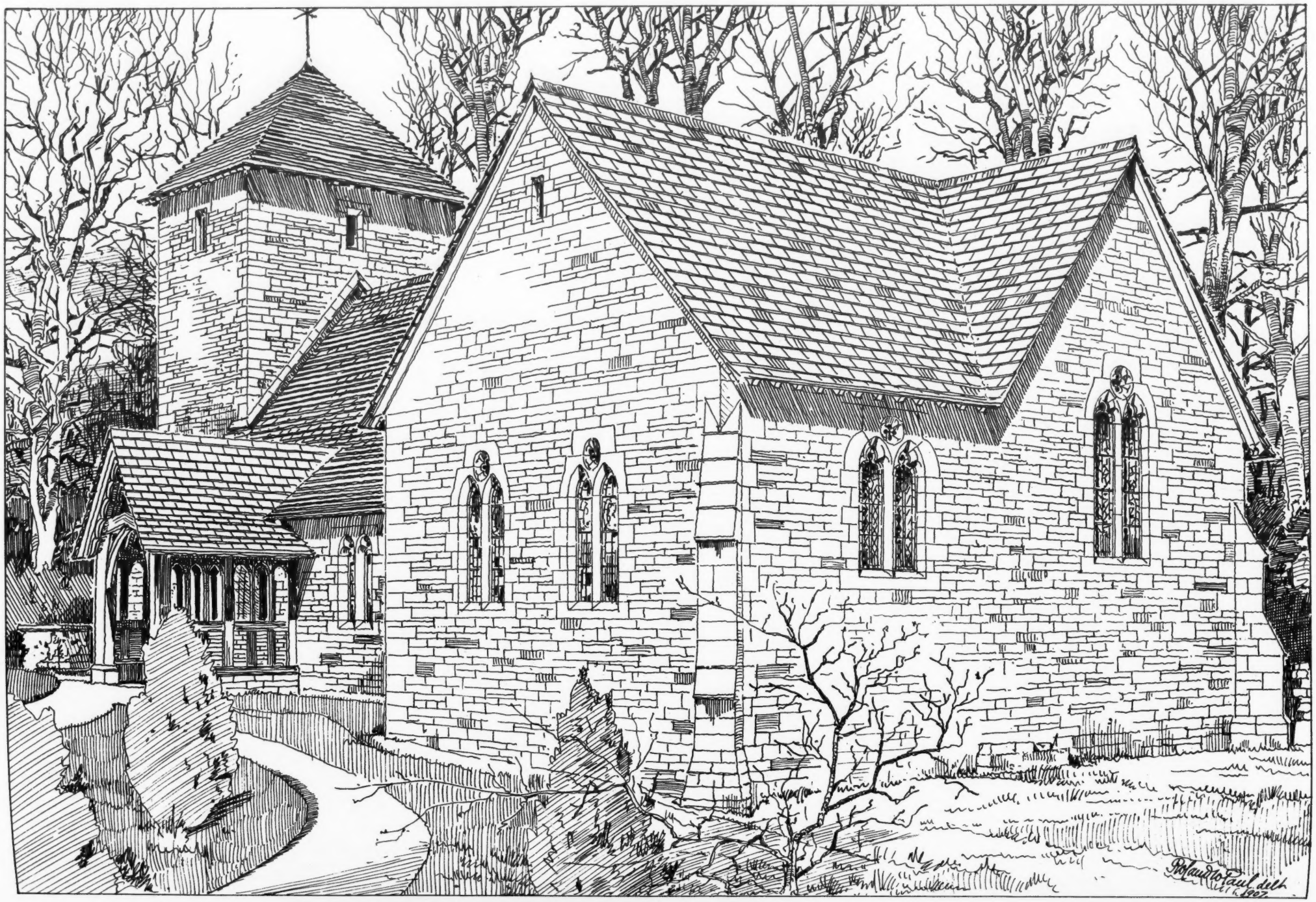

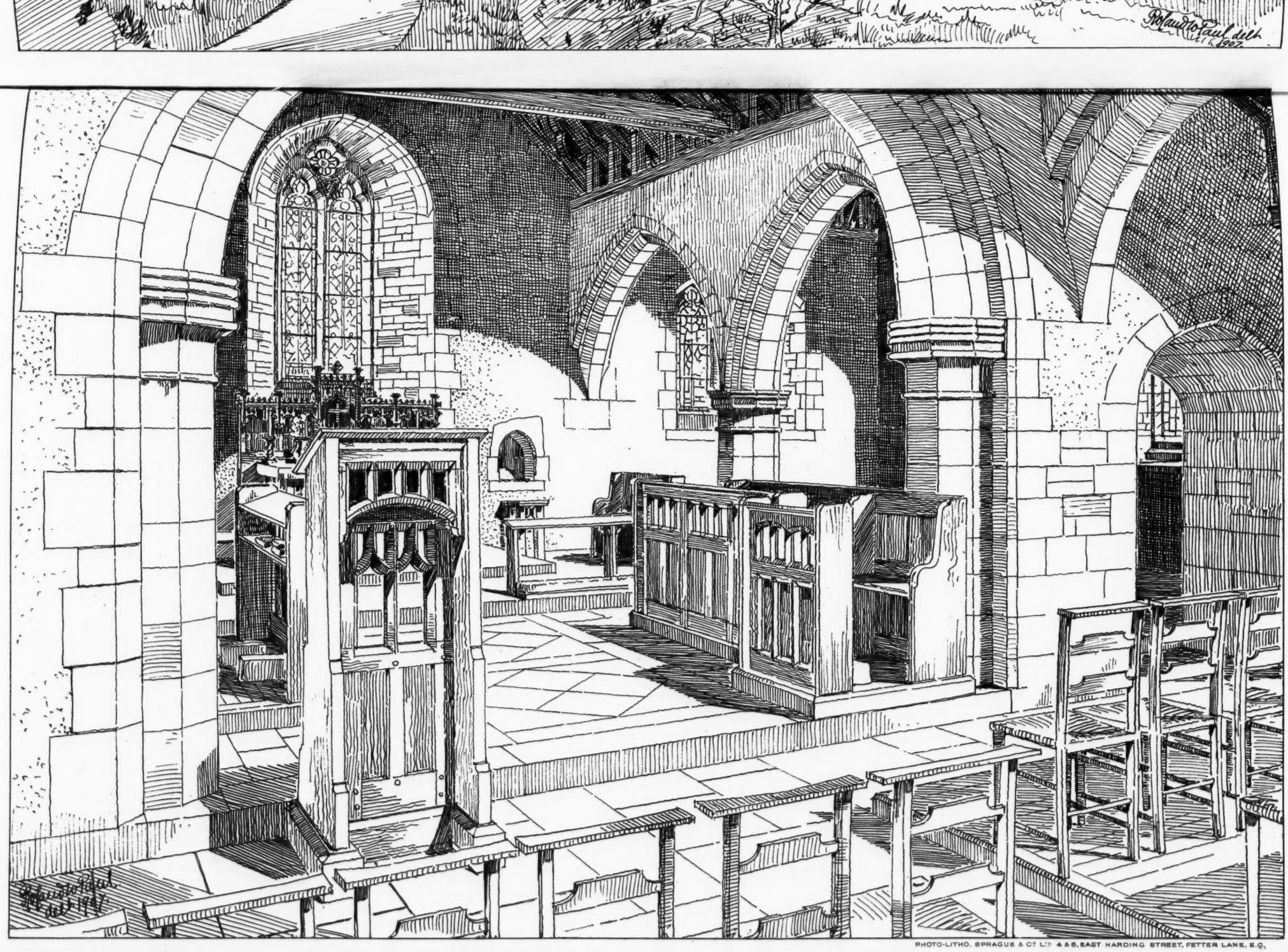

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